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717 NORTH HARWOOD
DALLAS, TEXAS 75201
TELEPHONE 214 981 3300
FACSIMILE 214 981 3400

HONG KONG
LONDON
SHANGHAI
SINGAPORE
TOKYO

FOUNDED 1866

WRITER'S DIRECT NUMBER
(214) 981-3328

WRITER'S E-MAIL ADDRESS
pplap@sidley.com

March 17, 2000

Assistant Commissioner
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DERRICK T. GORDON

Name of Applicant, Assignee, or Registered Representative

Derrick T. Gordon
Signature

MARCH 17, 2000

Date of Signature

Re: U.S. Patent Application
ELECTRONIC INFORMATION DEVICE AND CONTROL METHOD
THEREOF
By: Masahito NIIKAWA, Naoki MASAZUMI, Kiyofumi
HASHIMOTO, and Yasuhiro MORIMOTO
Attorney Docket: 15162/01620

Dear Sir:

Enclosed for filing are the following papers relating to
ELECTRONIC INFORMATION DEVICE AND CONTROL METHOD THEREOF,
Masahito NIIKAWA, Naoki MASAZUMI, Kiyofumi HASHIMOTO, and
Yasuhiro MORIMOTO, inventors:

- (1) Specification;
- (2) Executed Declaration and Power of Attorney;
- (3) Formal Drawings (28 sheets);
- (4) Certified Copy of Priority Document;

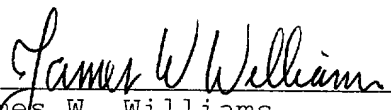
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Page 2

- (5) Assignment of the invention to Minolta Co., Ltd., with Recordation Form Cover Sheet;
- (6) Check in the amount of \$1,050.00 to cover the filing fee of the application; and
- (7) Check in the amount of \$40.00 to cover the assignment recordation fee.

In the event the attached checks in the amounts of \$1,050.00 and \$40.00 are not received with this correspondence, are not sufficient, or in the event additional fees are due, please charge the required fees (other than issue fee) during the pendency of this application to Deposit Account No. 18-1260. Please credit any overpayment to Deposit Account No. 18-1260.

All correspondence is to be directed to the Applicants' attorney at the Dallas address listed above.

Respectfully submitted,


James W. Williams
Registration No. 20,047
Attorney for Applicants

JWW/tjf

Enclosures

Attorney Docket No.: 15162/01620

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re

U.S. Application of: Masahito NIIKAWA, Naoki MASAZUMI,
Kiyofumi HASHIMOTO, Yasuhiro MORIMOTO

For: ELECTRONIC INFORMATION DEVICE AND
CONTROL METHOD THEREOF

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DERRICK T. GORDON

Name of Applicant, Assignee, or Registered Representative

Derrick T. Gordon
Signature

MARCH 17, 2000

Date of Signature

TRANSMITTAL OF PrintEFS PATENT APPLICATION BIBLIOGRAPHIC DATA

Submitted herewith is bibliographic data (3 pages) for the above-identified application, in the PrintEFS Version 1.0.1 program format.

Respectfully submitted,

James W. Williams

James W. Williams
Registration No. 20,047
Attorney for Applicants

JWW/tjf

SIDLEY & AUSTIN
717 N. Harwood
Suite 3400
Dallas, Texas 75201-6507
(214) 981-3328 (direct)
(214) 981-3300 (main)
March 17, 2000

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[illegible]

Inventor One Given Name:: Masahito
Family Name:: NIIKAWA
Postal Address Line One:: Minolta Co., Ltd., Osaka Kokusai Bldg.,
Postal Address Line Two:: 3-13, 2-Chome, Azuchi-Machi, Chuo-Ku
City:: Osaka-Shi
State or Province:: Osaka
Country:: JAPAN
Postal or Zip Code:: 541-8556
City of Residence:: Sakai-Shi
State or Province of Residence:: Osaka
Country of Residence:: JAPAN
Citizenship Country:: JAPAN
Inventor Two Given Name:: Naoki
Family Name:: MASAZUMI
Postal Address Line One:: Minolta Co., Ltd., Osaka Kokusai Bldg.,
Postal Address Line Two:: 3-13, 2-Chome, Azuchi-Machi, Chuo-Ku,
City:: Osaka-Shi
State or Province:: Osaka
Country:: JAPAN
Postal or Zip Code:: 541-8556
City of Residence:: Kobe-Shi
State or Province of Residence:: Hyogo-Ken
Country of Residence:: JAPAN
Citizenship Country:: JAPAN
Inventor Three Given Name:: Kiyofumi
Family Name:: HASHIMOTO
Postal Address Line One:: Minolta Co., Ltd., Osaka Kokusai Bldg.,
Postal Address Line Two:: 3-13, 2-Chome, Azuchi-Machi, Chuo-Ku,
City:: Osaka-Shi
State or Province:: Osaka
Country:: JAPAN
Postal or Zip Code:: 541-8556
City of Residence:: Suita-Shi
State or Province of Residence:: Osaka
Country of Residence:: JAPAN
Citizenship Country:: JAPAN
Inventor Four Given Name:: Yasuhiro
Family Name:: MORIMOTO
Postal Address Line One:: Minolta Co., Ltd., Osaka Kokusai Bldg.,
Postal Address Line Two:: 3-13, 2-Chome, Azuchi-Machi, Chuo-Ku,
City:: Osaka-Shi
State or Province:: Osaka
Country:: JAPAN
Postal or Zip Code:: 541-8556
City of Residence:: Takatsuki-Shi
State or Province of Residence:: Osaka
Country of Residence:: JAPAN
Citizenship Country:: JAPAN

CORRESPONDENCE INFORMATION

Name Line One:: James W. Williams
Name Line Two:: Sidley & Austin
Address Line One:: 717 North Harwood
Address Line Two:: Suite 3400
City:: Dallas
State or Province:: Texas
Country:: USA
Postal or Zip Code:: 75201
Telephone One:: (214) 981-3328
Fax One:: (214) 981-3400
Electronic Mail One:: pplap@sidley.com
Telephone Two:: (214) 981-3300
Electronic Mail Two:: jwilli09@sidley.com

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PRIOR FOREIGN APPLICATIONS

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ELECTRONIC INFORMATION DEVICE AND CONTROL METHOD THEREOF

This application is based on application No. 11-78117 filed in
5 Japan, the content of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

10 The present invention relates to various kinds of electronic information devices such as digital cameras, TV sets, personal computers, electronic books, man-machine interfaces, etc, and a control method of such a device.

2. Description of Related Art

15 With development of electronic information devices which require a display section to display images, such as computers, digital cameras, etc., various display devices using materials with a memory effect have been developed. For example, Japanese Patent Laid Open Publication No. 8-317324 describes an embodiment of adopting ferroelectric liquid
20 crystal to an electronic camera. Japanese Patent Laid Open Publication No. 10-197850 describes an embodiment of using ferroelectric liquid crystal in a display device for a pen computer so as to save energy.

Such a display device using a material with a memory effect has an advantage of consuming no electric power in maintaining a picture on
25 the display, while consuming electric power in writing information on the display. For example, Japanese Patent Publication No. 7-101336

discloses that a supply of electric power to a display panel with a memory effect is shut off after the display panel has made a display of a calendar, a picture, etc.

In the display device disclosed by Japanese Patent Publication No. 7-101336, however, if a supply of electric power is shut off during image writing on the display, an incompletely written picture stays on the display, which is ugly. Thus, in such a display device using a material with a memory effect, the display sequence must be changed. There is no prior art which focuses on a power-down during image writing on a display with a memory effect. If a supply of electric power is shut off suddenly, there may be a case that an incompletely written image is displayed continuously. In order to avoid such trouble, it is necessary to time a power-down of the display section to completion of image writing on the display, which is inconvenient.

Conventionally, only ferroelectric liquid crystal is regarded as a material with a memory effect. Recently, however, cholesteric liquid crystal and chiral nematic liquid crystal start to be used practically. For example, U.S. Patent No. 5,625,477 discloses a method of displaying a multi-tone image on chiral nematic liquid crystal.

Accordingly, in the art of display devices using materials with a memory effect, it is required to improve the control of image writing and power off so as to display a complete picture at all times. Further, in the art of electronic information device used as a man-machine interface which has an input section (including a power switch) with which an operator inputs a specified command and a display section with a memory effect, it is necessary to improve the association of the input section with

the display section to improve the operability.

SUMMARY OF THE INVENTION

5 An object of the present invention is to provide an electronic information device with a memory effect which never displays an incomplete picture continuously, and a control method of the electronic information device.

10 Another object of the present invention is to provide an electronic information device wherein an input section to be operated by an operator and a display section with a memory effect are associated well and which can be easily operated.

15 In order to attain the objects, an electronic information device according to the present invention comprises: a display which uses a material with a memory effect; an electric power source which supplies driving power to the display; and a controller which, in response to a command to turn off the electric power source which is issued while the display is performing writing by consuming electric power supplied from the electric power source, turns off the electric power source after
20 completion of the writing. The controller may be one which when an automatic power-off process is commanded while information is being written on the display, turns off the electric power source after completion of the writing.

25 With the arrangement, even if a power-off command is issued during writing on the display or even if an automatic power-off system works for energy saving, supply of electric power to the display is

continued until completion of the writing. Accordingly, it never occurs that an incomplete picture is continuously displayed. Especially, when information is written based on image data, because it has a large volume and requires a long time to be displayed, the delay of execution of a power-off is effective.

Another electronic information device according to the present invention comprises: a display using a material with a memory effect; a first input member with which an operator inputs a specified command; and a controller which when the first input member is operated during writing on the display, invalidates the command sent from the first input member and when the first input member is operated after completion of the writing, controls the electronic information device in accordance with the command sent from the first input member. In a display which uses a material with a memory effect, it takes a time to write information thereon. If a command from the first input member is accepted during writing, the writing will be discontinued and repeated from the beginning, which is inefficient. According to the present invention, since a command which is sent from the first input member during writing on the display is invalidated, the efficiency and the convenience of the device are improved.

There are, however, commands which shall be accepted regardless of whether or not writing on the display is being performed. For example, in a digital camera, it is preferred to accept a command sent from a shutter button even during writing on the display so as not to miss a shutter chance.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and features of the present invention will be apparent from the following description with reference to the
5 accompanying drawings, in which:

Fig. 1 is a sectional view of an exemplary liquid crystal display to be employed in a data storage medium;

Fig. 2 is a plan view which shows a state of forming a columnar structure and a sealant on a substrate of the liquid crystal display;

10 Fig. 3 is a block diagram showing a driving circuit of the liquid crystal display;

Fig. 4 is an illustration of a driving method of the liquid crystal display;

15 Fig. 5 is a perspective view of a first memory card which is used for an electronic information device according to the present invention;

Fig. 6 is a block diagram showing a circuitry of the memory card;

Fig. 7 is a perspective view of a second memory card;

Fig. 8 is a block diagram showing a circuitry of the memory card shown by Fig. 7;

20 Fig. 9 is a perspective view of a third memory card;

Fig. 10 is a perspective view of a fourth memory card;

Fig. 11 is a sectional view of the memory card shown by Fig. 10;

Fig. 12 is a block diagram of a circuitry of the memory cards shown by Figs. 9 and 10;

25 Fig. 13 is a block diagram showing a driving circuit of the liquid crystal display;

Fig. 14 is a front view of a first exemplary digital camera according to the present invention;

Fig. 15 is a rear view of the digital camera;

Fig. 16 is a side view of the digital camera;

5 Fig. 17 is a bottom view of the digital camera;

Fig. 18 is a block diagram showing a control circuit of the digital camera;

Fig. 19 is an illustration showing the state of the liquid crystal display before a format process;

10 Fig. 20 is an illustration showing an exemplary format of the liquid crystal display;

Fig. 21 is a flowchart showing a control procedure right after power-on of the digital camera;

15 Fig. 22 is a flowchart showing a control procedure of the liquid crystal display;

Fig. 23 is an illustration of a thumbnail picture on the liquid crystal display;

Fig. 24 is an illustration showing exemplary pictures to be displayed on an LCD section of the digital camera;

20 Fig. 25 is a rear view of a second exemplary digital camera according to the present invention;

Fig. 26 is a bottom view of the digital camera shown by Fig. 25;

Fig. 27 is an illustration showing another exemplary format of the liquid crystal display;

25 Fig. 28 is a flowchart showing a control procedure of the liquid crystal display in the second exemplary digital camera;

Fig. 29 is a flowchart showing a control procedure of the second exemplary digital camera in a photography mode;

Fig. 30 is an illustration of another exemplary picture on the liquid crystal display;

5 Fig. 31 is a flowchart showing a control procedure of the second exemplary digital camera in a reproduction mode;

Fig. 32 is an illustration showing another exemplary picture on the liquid crystal display;

10 Fig. 33 is a flowchart showing another control procedure of the second exemplary digital camera in the photography mode;

Fig. 34 is an illustration showing another exemplary picture on the liquid crystal display;

Fig. 35 is a block diagram showing the structure of a timing controller; and

15 Figs. 36 and 37 are flowcharts showing a control procedure in the photography mode including an automatic power-off process.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

20 Some embodiments of an electronic information device and a control method thereof according to the present invention are described with reference to the accompanying drawings.

General Structure of Memory Card with Memory-effective Liquid Crystal

25 First, a memory card which is provided with liquid crystal with a memory effect (which will be hereinafter referred to as a memory card with memory-effective liquid crystal) is described. The memory card is

is a sealant to seal the liquid crystal composition 18 in the transparent substrates. If necessary, insulating layers and alignment controlling layers may be provided on the transparent electrodes 15 and 16 on the substrates 11 through 14.

5 The liquid crystal display 10 has a red display layer R, a green display layer G and a blue display layer B which are placed one upon another in this order on a light absorber 20. The red display layer R makes a display by switching between a red selective reflection state and a transparent state. The green display layer G makes a display by
10 switching between a green selective reflection state and a transparent state. The blue display layer B makes a display by switching between a blue selective reflection state and a transparent state.

 In the liquid crystal display 10, the liquid crystal performs selective reflection when it is in a planar state and becomes transparent
15 when it is in a focal-conic state. By switching the liquid crystal between these state, the liquid crystal display 10 makes a display. When the liquid crystal is in a planar state, it selectively reflects light of a wavelength $\lambda = Pn$ (P: helical pitch of the cholestric liquid crystal, n: average refractive index of the liquid crystal).

20 If the wavelength of light selectively reflected by the cholesteric liquid crystal is within the infrared spectrum, when the liquid crystal is in a focal-conic state, it scatters visible light. If the wavelength of light selectively reflected by the cholesteric liquid crystal is shorter than the infrared spectrum, the liquid crystal, in a focal-conic state, transmits
25 visible light. Accordingly, by providing a light absorber 20 on the side of the liquid crystal display 10 opposite the observing side (indicated by

arrow "A") and by setting the wavelength of light selectively reflected by the liquid crystal within the visible spectrum, display of a specified color (made in a planar state) and black (made in a focal-conic state) is possible. Also, by setting the wavelength of light selectively reflected by the liquid
5 crystal within the infrared spectrum, display of black (made in a planar state) and white (made in a focal-conic state) is possible.

By applying a voltage of a first threshold value V_{th1} which is the threshold voltage to untwist the cholesteric liquid crystal for a sufficient time and thereafter dropping the voltage lower than a second threshold
10 value V_{th2} which is smaller than V_{th1} , the liquid crystal comes to a planar state. Also, by applying a voltage higher than V_{th2} and lower than V_{th1} to the liquid crystal for a sufficient time, the liquid crystal comes to a focal-conic state. These states can be maintained even after application of a voltage. It has been known that there is a state where
15 these two states are mixed and that a display of intermediate tones is possible (refer to U.S. Patent No. 5,384,067).

As Fig. 3 shows, the pixels of the liquid crystal display 10 are structured in a matrix composed of a plurality of scan electrodes R1, R2 through Rm and data electrodes C1, C2 through Cn (m, n: natural
20 numbers). The scan electrodes R1 through Rm are connected to output terminals of a scan electrode driving circuit 21, and the data electrodes C1 through Cn are connected to output terminals of a data electrode driving circuit 22.

The scan electrode driving circuit 21 outputs a selective signal to
25 specified ones of the scan electrodes R1 through Rm so as to set the specified scan electrodes to a selected state while outputting a non-

selective signal to the other scan electrodes so as to set the scan electrodes come to a non-selected state. The scan electrode driving circuit 21 outputs the selective signal to the scan electrodes R1 through Rm in order while switching at regular intervals. In the meantime, the data
5 electrode driving circuit 22 outputs a signal in accordance with image data to the data electrodes C1 through Cn for rewriting of the pixels on the scan electrodes in a selected state. For example, when a scanning electrode Ra (a : natural number, $a \leq m$) is selected, displayed information on the pixels LRa-C1 through LRa-Cn at the intersections of the scanning
10 electrode Ra and the data electrodes C1 through Cn is rewritten. Thus, in each pixel, the difference between the voltage applied to the scan electrode and the voltage applied to the data electrode is a rewriting voltage, and each pixel is rewritten in accordance with this rewriting voltage.

15 Referring to Fig. 4, displaying an image of which image data are expressed by a matrix $[P_{ij}]$ composed of m rows and n columns is described. First, a pulse voltage in accordance with data for the first line indicated by row vectors $P_{11}, P_{12} \dots P_{1n}$ is applied to the data electrodes C1, C2 ... Cn, while only the scan electrode R1 selected from the scan
20 electrodes R1 through Rm is charged to a specified voltage. Thereby, the pixels in the first line, namely, L11, L12 ... L1n come to a planar state or to a focal-conic state. Thereafter, when the application of voltage to the scan electrode Ra is stopped, the display states of the pixels L11, L12 ... L1n are maintained.

25 In the same way, a pulse voltage in accordance with data for the "i"th line indicated by row vectors $P_{i1}, P_{i2} \dots P_{in}$ is applied to the data

electrodes C1, C2 ... Cn, while only the scan electrode Ri selected from the scan electrodes R1 through Rm is charged to the specified voltage. Thereby, the pixels in the "i"th line, namely, Li1, Li2 ... Lin come to a planar state or to a focal-conic state. Thereafter, when the application of
5 voltage to the scan electrode Ri is stopped, the display states of the pixels Li1, Li2, ... Lin are maintained. By applying this procedure to all the "i" ($1 \leq i \leq m$) repeatedly, the image [Pij] is completely displayed, and the display state is maintained.

By carrying out the above-described matrix drive toward the
10 display layers B, G and R in order or simultaneously, a full-color image can be displayed on the liquid crystal display 10. Further, by driving the liquid crystal with the image data [Pij] changed as time goes by, display of a motion picture is possible.

Materials for Liquid Crystal Display and Producing Method Thereof

15 As the transparent substrates, transparent glass substrates and polymer films can be used. The polymer films mean, for example, resin such as polyether sulfone, polycarbonate, polyethylene terephthalate.

As the electrodes, transparent electrodes such as ITO, NESA coat, etc. are usable, and such a material is formed into the electrodes by
20 sputtering or vapor deposition. The lowermost electrodes may be black electrodes so as to also function as a light absorber.

As the liquid crystal composition, it is preferred to use a material which exhibits a cholesteric phase in a room temperature. What is suited as the material is chiral nematic liquid crystal which is produced
25 by adding a chiral agent to nematic liquid crystal. Although nematic liquid crystal is not limited to the followings, mixtures mainly containing

41, a connector 46 of the PCMCIA standard is provided. When this memory card 40 is used, it is fitted in an electronic information device with a connector of the PCMCIA standard, such as a digital camera, a personal computer or the like, in the direction "X".

5 Electric power is supplied to the memory card 40 from the electronic information device. However, because the display section comprises liquid crystal with a memory effect, even when the memory card 40 is taken out of the electronic information device and is not supplied with electric power, the liquid crystal display 10 is capable of
10 keeping a display thereon. Descriptions of display modes will be given later. The connector 46 functions not only to input and output electric power and a signal to and from the memory section but also to input and output electric power and a drive signal to and from the driving circuits 21 and 22 of the liquid crystal display 10.

15 Memory Section/Display Section Separate Type

The memory section/display section separate type memory cards can be further divided into two type, namely, an adapter type which permits use of conventional memory cards (without the liquid crystal display 10) and a display section sticking type which facilitates an
20 exchange of liquid crystal displays when the liquid crystal display 10 ages and degrades.

Adapter Type

Figs. 7 and 8 show a compact flash memory card 50 which is widely used as a data storage medium for a digital camera and a PC card
25 adapter 52 for the memory card 50. The PC card adapter is provided with the above-described liquid crystal display 10. The picture on the

display 10 can be seen through a transparent plastic window 53. The memory card 50 is fitted in a frame 54 of the adapter 52 in the direction "X₁". Thereby, a connector 51 connected to the driving circuit 45 comes in contact with a connector 55 provided on the adapter 52. The
5 connector 55 is connected to a connector 46 which is provided on an end surface of the adapter 52. In Figs. 7 and 8, the same members are denoted by the same reference symbols as those in Figs. 5 and 6.

Display Section Sticking Type

As Fig. 9b shows, on a surface of a casing 57 of a compact flash
10 memory card 56, a recess 58 in which a display section is to be placed is formed. In the recess 58, electrodes 59 for a drive of the display section are formed. The liquid crystal display 10 is joined to a support 25 integrally. On the reverse side of the support 25, electrodes 26 which are electrically connected to the driving circuits 21 and 22 are formed. When
15 the center portion of the reverse side of the support 25 is stuck to the recess 58 by a double-side sticky tape or an adhesive, the electrodes 26 and 59 are electrically connected to each other.

The recess 58 has a projection 58a, and the support 25 has a cut-out 25a. In fitting the liquid crystal display 10 in the casing 57, the cut-
20 out 25a must be engaged with the projection 58a, and there is no possibility that the liquid crystal display 10 may be fitted in a wrong way. The support 25 is slightly smaller than the recess 58. The depth of the recess 58, the thickness of the electrodes 26 and 59, the thickness of the support 25 and the thickness of the display 10 are so designed that the
25 surface of the display 10 will be on a level with the surface of the memory card 56 when the display 10 is fitted in the memory card 56. Therefore,

there is no fear that the liquid crystal display 10 may come off when this memory card 56 is fitted in a digital camera or a personal computer. Also, when the display section is to be changed because of aging or damage of the liquid crystal or by any reason, the changing work is easy.

5 The display section may be inserted in the memory card through a slot. Figs. 10 and 11 show an example of this way of fastening the display section to the memory card. In a casing 61 of a compact flash memory card 60, a slot 62 is provided on the opposite side to the side where the connector 46 is provided. A display section, which comprises
10 a support 27 and the above-described liquid crystal display 10 fitted thereon, is inserted in the memory card 60 through the slot 62. By inserting the display section in the direction "X₁" through the slot 62 to the end, the electrodes 26 of the liquid crystal display 10 are electrically connected to the electrodes 59 (see Fig. 12) provided in the casing 61.

15 On a surface of the casing 61, a transparent plastic window 63 is provided in a portion where the liquid crystal display 10 is to be placed. Thus, when the display section is inserted in the memory card 60, it can be used as a memory card with memorizable liquid crystal. Further, a lever 64 is provided on the casing 61 so that the display section can be
20 taken out of the slot 62. This take-out mechanism comprising the lever 64 is of a conventional type for a slot of the PCMCIA standard, and a description thereof is omitted.

Fig. 12 shows a circuit of a memory card of the memory section/display section separate type as shown by Figs. 9 and 10. The
25 same members of the circuit shown by Fig. 12 are denoted by the same reference symbols as those in Fig. 6, and descriptions of these members

are omitted.

Driving Circuit

Now referring to Fig. 13, a mechanism of displaying the content of image data on the liquid crystal display 10, especially the scan electrode driving circuit 21 and the data electrode driving circuit 22 are described in detail. Fig. 13 shows the members working for a drive of the liquid crystal display 10. Although the flash memories 43 and 44 are actually installed in the memory card, a driving circuit for the memories 43 and 44 is well-known, and a description thereof is omitted.

The memory card with memory-effective liquid crystal is based on the PCMCIA standard which is controlled by a CPU of a digital camera, a personal computer or the like via a card interface. Accordingly, the memory card has four terminals, namely, a data bus, an address bus, a control bus and a power/grounding line although they are not shown. When an image is displayed on the liquid crystal display 10, a CPU of a digital camera, a personal computer or the like dispatches a writing command to the control bus, designates an address and outputs data.

In accordance with the output of data, first, image data for the first line are stored in a line buffer 71. A timing controller 70 times so that on completion of the storage, the image data for the first line can be read out simultaneously for the respective columns and converted from eight-bit data into analog image signals by D/A converters 72.

From an electric power source of the digital camera or the personal computer, a voltage of +5V is applied to this driving circuit via the memory card interface. In driving the liquid crystal display 10, however, in order to cause the liquid crystal to come to a focal-conic state

installed outside the memory card.

Driving Section Internally Installed Type

The driving section internally installed type means that the whole driving circuit for the liquid crystal display 10 is installed in the memory card. Accordingly, by receiving only RGB data from outside, the liquid crystal display 10 can make a complete picture thereon. This requires easy control. In a case of using an interface for general use such as the PCMCIA standard as described above, this type must be used.

Driving Section Externally Installed Type

The driving section externally installed type means that part of the driving circuit for the liquid crystal display 10 is installed in a device such as a digital camera, a personal computer or the like in which the memory card is to be inserted when it is used. Accordingly, this decreases the size and the cost of the memory card.

In the driving circuit shown by Fig. 13, it is preferred to install the part which is enclosed by a double line in the memory card. The other part can be installed in a digital camera, a personal computer or the like. By installing at least the part enclosed by the double line in the memory card, even if a larger number of electrodes become necessary with an increase in number of the display pixels, the number of pins of the connector may not be increased so much.

Digital Camera Which can Employ Memory Card

with Memory-effective Liquid Crystal

A digital camera which can employ the above-described memory card with memory-effective liquid crystal as a storage medium of photo data.

Since the memory card has a display section, it is possible to display any information about the digital camera on the display section of the memory card. First, however, a type which further has a display section for the digital camera besides the display section of the memory
5 card is described.

Display Section Separate Type

Structure of Digital Camera

As Figs. 14 through 17, a digital camera 100 comprises a camera body 102 and an image pick-up unit 103. The image pick-up unit 103 is
10 attached to the right side of the camera body 102 viewed from the front side and is detachable from the camera body 102.

The image pick-up unit 103 has a conventional CCD 303 which functions as a color area sensor (see Fig. 18) at a suitable place in the rear side of a zoom lens 301 with a macro function. As in a camera using a
15 silver salt film, a demodulating circuit 304 with a demodulating sensor 305 which receives reflection of flash light from an object, a distance sensor 306 which measures the distance to an object and an optical finder 307 are provided at suitable places inside the image pick-up unit 103.

In the image pick-up unit 103, also, a zoom motor M1 (see Fig. 18)
20 which moves the zoom lens 301 for a change in zoom ratio and for movement between a retreating position and a photography position and a motor M2 which carries out focusing are provided.

On the front side of the camera body 102, a grip 104, a built-in flash 105 and an IRDA port 106 which performs infrared communication
25 between the digital camera 100 and an external device (for example, another digital camera, a personal computer or the like) are provided.

On the upper side of the camera body 102, a shutter button 109 is provided.

As Fig. 15 shows, on the rear side of the camera body 102, an LCD section 110 which makes a monitor display (corresponding to a viewfinder) and reproduces a stored image is provided in the center. Below the LCD section 110, a key switch group 111 for control of the digital camera 100 and a power switch 112 are provided. On the left side of the power switch 112, an LED 113 which is lit when the power switch 112 is on and an LED 114 which indicates the middle of an access to the memory card are provided.

Further, on the rear side of the camera body 102, a photography/reproduction mode setting switch 120 for switching between a photography mode and a reproduction mode is provided. The photography mode is to take a photograph, and the reproduction mode is to reproduce an image stored in the memory card on the LCD section 110. The photography/reproduction mode setting switch 120 is a two-contact slide switch. For example, by sliding the switch 120 downward, the reproduction mode is set, and by sliding the switch 120 upward, the photography mode is set.

On the rear side of the camera body 102, in the right side, a four-throw switch is provided. By pressing buttons 121 and 122 of the four-throw switch, the zoom motor M1 is driven for zooming, and by pressing buttons 123 and 124 of the four-throw switch, exposure adjustment is performed.

As shown in Fig. 15, on the rear side of the image pick-up unit 103, an LCD button 311 and a macro button 312 are provided. Every time the

LCD button 311 is pressed, the LCD section 110 is turned on or off. For example, in taking photographs while using only the optical finder 307, the LCD section 110 shall be turned off to save energy. By pressing the macro button 312, the focus motor M2 is driven to permit macro imaging of the lens 301.

As Fig. 16 shows, on a side of the digital camera 100, a DC input terminal 308 and a video output terminal 309 are provided. The video output terminal 309 is to output an image displayed on the LCD section 110 to an external video monitor.

As Fig. 17 shows, on the bottom of the camera body 120, a battery room 131 and a card room 132 for a memory card are provided, and these rooms are closed by a clamshell type cover 130. This digital camera 100 requires four AA batteries which are serially connected as its driving source 135. Further, on the bottom side, a disconnecting lever 136 to disconnect the image pick-up unit 103 and the camera body 102 which are connected by a connector and a hook from each other is provided.

Control Circuit

Next, referring to Fig. 18, a control circuit of the image pick-up unit 103 is described.

The CCD 303 performs photoelectric conversion of an optical image of an object which has been obtained by the macrozoom lens 30 to output color image signals of R, G and B (signals each of which is composed of rows of pixel data). A timing generator 314 generates various timing pulses for control of the CCD 303.

In the image pick-up unit 103, since the stop is fixed, the exposure adjustment is performed by adjusting the exposure of the CCD 303 and

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reflected light from an object irradiated by flash light, and when the quantity of light received by the sensor 305 reaches a specified value, a lighting stop signal is outputted from the demodulating circuit 304. A flash driving circuit 216 stops light emission of the built-in flash 105 in response to the lighting stop signal. Thus, the quantity of light emitted from the flash 105 is controlled.

The image pick-up unit 103 and the camera body 102 are electrically connected to each other by seven connector groups 334a, 334b, 334c, 334d, 334e, 334f and 334g which are provided on the fitting surface 334 of the image pick-up unit 103 and by seven connector groups 234a, 234b, 234c, 234d, 234e, 234f and 234g which are provided on the connecting surface 234 of the camera body 102.

Next, a control circuit of the camera body 102 is described.

In the camera body 102, an A/D converter 205 converts each signal for a pixel of the image signals into a ten-bit digital signal. Based on an A/D/ conversion clock sent from the timing control circuit 202, each pixel signal (analog signal) is converted into a 10-bit digital signal.

The timing control circuit 202 generates a reference clock and clocks to be outputted to the timing generator 314 and the A/D converter 205 and is controlled by the central control section 211.

A black level adjusting circuit 206 adjusts the black level of the A/D converted pixel signal (hereinafter referred to as pixel data) to a specified black level. A WB circuit 207 changes the levels of the pixel data of the respective colors R, G and B so that the white balance will be appropriate after γ correction. The WB circuit 207 uses a level conversion table sent from the central control section 211 in changing the

levels of the RGB color pixel data. The conversion coefficients (inclinations of characteristics) for the respective colors in the level conversion table are determined by the central control section 211 for every photography.

5 A γ correcting circuit 208 is to correct the γ characteristic of pixel data. An image memory 209 is to be stored with pixel data outputted from the γ correcting circuit 208. The image memory 209 has a storage capacity for one-frame data. More specifically, if the CCD 303 has pixels arranged in n columns and in m rows, the image memory
10 209 has a capacity of pixel data for $n \times m$ pixels, and data for the respective pixels are stored in respective places in the memory 209.

A VRAM 210 is a buffer memory for image data to be reproduced on the LCD section 110. This VRAM 210 has a storage capacity of image data corresponding to the number of pixels of the LCD section 110.

15 During a stand-by for photography, images are picked up by the image pick-up unit 103 at regular time intervals. Pixel data of each picked-up images are subjected to specified signal processing by the A/D/converter 205 through the γ correcting circuit 208 and stored in the image memory 209. Simultaneously, the data are transmitted to the
20 VRAM 210 via the central control section 211 to be displayed on the LCD section 110 (display of a live view image). From the image displayed on the LCD section 110, the user can obtain a vision of the object. In the reproduction mode, image data read out from the memory card are subjected to specified signal processing at the central control section 211,
25 and the data are transmitted to the VRAN 210 to be displayed on the LCD section 110.

control circuit 211, and therefore, the central control section 211 is provided with a ROM (not shown) to be stored with a work memory and a program.

Also, the central control section 211 has a luminance judging
5 section and a shutter speed setting section to determine the exposure
value (shutter speed). The luminance judging section judges the
brightness of an object using images picked up by the CCD 303 at
intervals of 1/30 second during a stand by for photography. In other
words, the luminance judging section judges the brightness of an object
10 using image data which are renewably stored in the image memory 209.
The shutter speed setting section sets a shutter speed (integrated time of
the CCD 303) based on the judgment of the luminance judging section.

Further, the central control section 211 has a filter section which performs a filtering treatment for recording of a photographed image, an image recording section which produces a thumbnail image and a compressed image and an image reproducing section which reproduces an image to be displayed on the LCD section 110 from data stored in the memory card.

The filter section adjusts the high-frequency component of an
 20 image to be recorded by a digital filter so as to correct the picture quality
 with respect to the outline.

The image recording section reads pixel data from the image memory 209 and produces a thumbnail image and a compressed image to be stored in the memory card. The image recording section reads data of every eight pixels in the horizontal direction and in the vertical direction while scanning the image memory 209 in a raster scanning direction and

transmits the pixel data to the memory card in order, whereby a thumbnail image is produced and recorded in the memory card.

The image recording section reads all the pixel data of one image from the image memory 209 and performs two-dimensional DCT conversion and a compression treatment based on a JPEG method, such as a Huffman encoding method, toward the pixel data to produce data for a compressed image. Then, the compressed image data are recorded in an image area of the memory card.

In the photography mode, when the shutter button 109 is pressed for a command of photography, the central control section 211 processes the image which has been photographed and taken in the image memory 209 to a thumbnail image and a compressed image by applying a compression treatment based on the JPEG method at a ratio set by a compression ratio setting switch. Then, the compressed image is stored in the memory card with tag information about the photographed image (frame number, exposure value, shutter speed, compression ratio, date of photography, on/off of the flash, scene information, result of judgment of the image, etc.).

In each frame of the digital camera 100, tag data, high-resolution image data compressed based on the JPEG method (1600×1200 pixels) and thumbnail image data (80×60 pixels) are recorded. The volume of data recorded in one frame is approximately 1MB.

When the photography/reproduction mode setting switch 120 is set to the reproduction mode, image data in the frame of the highest number are read out of the image memory, and the data are expanded by the image reproducing section. Then, the expanded data are

transmitted to the VRAM 210, whereby the image in the frame of the highest number, that is, the latest photographed image is displayed on the LCD section 110. By operating an UP switch 111a, an image in the higher frame number is displayed, and by operating a DOWN switch 111b,
5 an image in the lower frame number is displayed.

Display Sequence of Liquid Crystal Display

An exemplary sequence of displaying data on the liquid crystal display 10 of a display section separate type digital camera is described.

(1) Renewal of Image on Card

10 The memory card 56 shown by Fig. 9 which is of a memory section/display section separate type and of a driving section internally installed type is shown by Figs. 19 and 20 again and is described as an exemplary memory card fitted in the digital camera 100. As mentioned above, the memory card 56 is compatible with conventional ordinary
15 memory cards. The liquid crystal display 10 comprises 300 pixels in each row and 400 pixels in each column, and the electrodes 15 and 16 are formed in accordance with the arrangement of the pixels.

Such memory cards 56 in a non-display state are distributed to users (see Fig. 19). In the control procedure described below, after a user
20 fits the memory card 56 in the digital camera 100, a thumbnail picture on the liquid crystal display 10 is renewed every time a photograph is taken.

Fig. 21 is a flowchart of the control procedure. When the digital camera 100 is turned on, first at step S10, the presence or absence of a
25 memory card in the camera 100 is judged. If there is no card, a warning is displayed at step S11. If there is a card, it is judged at step S12

If a format is necessary, a format process is performed at step S15.

At step S15, a format process is started after the user's confirmation, and during the format process, the central control section 211 performs writing on the liquid crystal display 10 via the card I/F 212. After completion of the format process, a framework 80 for thumbnail images, the number of photographed frames 82 and the remaining capacity of the card 83 are displayed on the liquid crystal display 10. A thumbnail image of one frame is of a size of 80×60mm, and a space for display of information must be set in the periphery. Accordingly, thumbnail images of 16 frames can be displayed. Further, depending on the frame size of the digital camera and the capacity of the memory card, more than 16 photographs can be taken. In this case, thumbnail images of all the frames are displayed by reducing the size of each image, or only thumbnail images of the latest used 16 frames are displayed.

If a format process is unnecessary (“NO” at step S14), a flag is checked at step S16 to judge whether or not the digital camera 100 is in a state right after the memory card with memory-effective liquid crystal
25 has been fitted therein. This flag is 0 while there is no memory card in

the digital camera 100. When a memory card is fitted in the digital camera 100, the flag is set to 1. Accordingly, by checking the state of this flag, the presence or absence of a memory card in the digital camera 100 can be judged.

5 Right after fitting of a memory card in the digital camera 100, there is a possibility that the picture on the liquid crystal display may be out of order, and therefore, although photography has not been performed yet, the picture on the liquid crystal display is renewed at step S17. More specifically, thumbnail images are read out from the memory card
10 and displayed. Thereafter, the liquid crystal display is controlled at step S18.

Referring to Fig. 22, a liquid crystal display control procedure performed at step S18 is described. First at step S21, the mode of the camera is judged. If the photography mode is set, processes at steps S22
15 through S24 are performed. It is judged at step S22 whether or not the shutter button 109 has been fully pressed, that is, has come to the state S2. When the shutter button 109 has been fully pressed, at step S23, image data processing of a photographed image is performed, and the data are recorded into a flash memory of the memory card 56. At step
20 S24, the thumbnail picture on the liquid crystal display 10 is renewed. More specifically, as Fig. 23 shows, thumbnail images 85 and frame numbers of photographed images are displayed in the respective display sections for the frames. Simultaneously, the number of used frames 82 and the remaining capacity 83 of the memory card 56 are renewed. Then,
25 other processes in the photography mode are carried out at step S25, and the program goes to step S33.

“memory card format” selected in the picture D1, a picture D2, which shows that a format process is being performed, appears. On completion of the format of the memory card, the display returns to the picture D1.

When the execution key 111d is pressed with “photo data deletion” selected in the picture D1, a picture D3, which shows all the photographed images, appears. In this state, by operating the four-throw key 121 through 124, a specified image can be selected, and the selected image is enclosed by a frame 90. Then, by pressing the key 111d, the data of the selected image are deleted. When a return key 111f is pressed, the display returns to the picture D1.

Referring to Fig. 22 again, this operation is described. It is judged at step S26 whether or not format of the memory card has been commanded. When the format is designated and commanded, a format process of the memory card is performed at step S27. Next, the picture on the liquid crystal display 10 is renewed at step S28, and more specifically, all the thumbnail images are erased.

When deletion of a photographed image is commanded (“YES” at step S29), data of the designated frame are deleted at step S30, and the thumbnail picture on the display 10 is renewed at step S31. More specifically, if data of the “n”th frame are deleted, image data of the “n+1”th frame is restored as image data of the “n”th frame, and the thumbnail image of this frame is displayed in the section for the “n”th frame. These processes are performed to all the image data of the “n+1”th and subsequent frames. At step S32, other processes in the reproduction mode are carried out, and the program goes to step S33.

At steps S33 through S35, electric power is shut off. It is judged

at step S33 whether or not a command of power off has been issued by operation of the power switch 112. If power off has not been commanded, the program returns to the main routine. If power off has been commanded, completion of renewal of the thumbnail picture is waited at
5 step S34, and a power-off process is performed at step S35. Thereby, there is no trouble that power may be turned off in the middle of renewal of the thumbnail picture.

Display Section Commonly Used Type

Since the memory card according to the present invention has a
10 liquid crystal display section, it is possible to display not only the content of the memory card but also information about a digital camera on the display section. In the following, a digital camera 100' which commonly uses a display section of a memory card is described. Figs. 14 and 16 are also a front view and a side view of this camera 100'. Figs. 25 and 26 are
15 a rear view and a bottom view of the digital camera 100', respectively. The same members are denoted by the same reference symbols as shown in Figs. 14 through 17, and repetition of descriptions of these members is omitted. Although a case of using the memory card shown by Fig. 9 will be described, needless to say, memory cards of other types can be used.

20 Referring to Figs 25 and 26, on a display support 140 provided on the rear side of the camera body 102, a card slot 141 and a connector 142 for the memory card 56 are provided. The memory card 56 is inserted in the camera 100' through the lower side of the display support 140. On the rear side of the display support 140, in a place facing the liquid crystal
25 display 10 of the memory card 56, a window 143 is formed. Thereby, when the memory card 56 is inserted, the screen of the liquid crystal

display 10 can be seen, and in this state, the liquid crystal display 10 can be also used as a display section of the camera 100'.

Further, the digital camera 100' has, in the camera body 102, an LCD section 110 using conventional TFT liquid crystal which emits light from a back light. Because the renewal speed of the liquid crystal display 10 is relatively low, the LCD section 110 is exclusively used to display a motion picture. By pressing the LCD button 311, the LCD section 110 can be turned on and off. If low-speed renewal of a motion picture is permissible, the LCD section 110 is not always necessary. If the LCD section 110 is not provided, the LCD button 311 is unnecessary.

An operation sequence in a case of using the liquid crystal display 10 of the memory card 56 as a display section of a camera is described.

(1) Case of Not Providing LCD Section 110

In this case, from the control circuit shown by Fig. 18, the VRAM 210, the LCD section 110 and the back light 160 are omitted. The omission of the back light 160 especially reduces the consumption of electric power, which prolongs the lives of the batteries.

Processes after power-on are performed in a similar way to the flowchart shown by Fig. 21. However, since a display section is not provided, the warning display of indicating no card at step S11 is made by flickering of the LED 114. After format, the display section of the card is in a state shown by Fig. 27, where the framework 80 for thumbnail images (see Fig. 20) are not displayed. In this display section commonly used type, there are various kinds of information to be displayed on the liquid crystal display 10 as well as thumbnail images, and it is not desirable to display the thumbnail framework 80 after form at all times.

On the other hand, when the display area is large, although it takes a longer time for renewal, the details of the object can be recognized because the number of used pixels is large. In this way, by changing the size of the live view display area depending on the purpose, both the efficiency and the visibility can be satisfied.

Referring back to Fig. 29, it is judged at step S62 whether or not the shutter button 109 is in the half-pressed state S1. If the button 109 is not in the state S1, it is judged at step S63 whether or not the liquid crystal display 10 is in the middle of image writing. If not, it is judged at step S71 whether or not any other key is operated. If there is no operation of keys, the central control section 211 commands supply of electric power to the image pick-up unit 103 at step S73 and commands pick-up of a live view image at step S74. Thereafter, image data are stored in the image memory 209 at step S75, and on completion of the storage of image data, the power supply to the image pick-up unit 103 is shut off at step S76. Next, at step S77, in accordance with the image data stored in the image memory 209, writing of a live view image on the liquid crystal display 10 is started. Then, the program returns to step S62.

After completion of the writing, as long as operation of no keys other than the shutter button 109 is recognized ("NO" at step S71), pick-up of a next live view image is performed at step S74. Thus, the completion of renewal of the image on the liquid crystal display 10 is used as a trigger to command the image pick-up unit 103 to pick up a live view image. Thereby, during writing of a live view image on the liquid crystal display 10, the CCD 303 can be turned off, which promotes saving of

electric power. Further, the trigger to command pick-up of a next live view image is not have to be the completion of image writing which is judged at step S63 and may be a time a little earlier than the completion of image writing.

5 In this control procedure, when "NO" at step S63, the program goes to step S71. This means that during image writing on the liquid crystal display 10, operation of any key is not inputted. With this arrangement, there is no possibility that whenever operation of any key is received in the middle of image writing, the image writing is performed
10 again from the beginning, that is, it never takes so long a time for renewal of the image on the liquid crystal display 10, and the efficiency of this camera 100' is highly improved.

 When the shutter button 109 is in the half-pressed state S1 ("YES" at step S62), the image pick-up unit 103 is turned on at step S64,
15 and an AF process and an AE process are performed at step S65. Thereafter, when it is judged at step S66 that the shutter button 109 comes to the full-pressed state S2, data of an image photographed by the CCD 303 are taken in at step S68, and the image data are stored in the flash memory of the memory card 56 at step S69. Then, the image pick-
20 up unit 103 is turned off at step S70, and the program goes to step S71.

 On the other hand, if the shutter button 109 does not come to the state S2 ("NO" at step S66), it is judged at step S67 whether or not the shutter button 109 is in the state S1. If the shutter button 109 is in the state S1, the program returns to step S65. If the shutter button 109 is
25 not in the state S1, the power supply to the image pick-up unit 103 is shut off at step S70, and the program goes to step S71.

Although operations of keys are not received during image writing on the liquid crystal display 10, only when the shutter button 109 is in the state S1, operations of keys are received. Therefore, the user never misses a shutter chance.

5 When an operation of any other key is recognized at step S71, a process in compliance of the operation of the key is performed at step S72. For example, when a mode change to the reproduction mode is commanded, a reproduction mode process, which will be described below, is performed.

10 Now referring to Fig. 31, a control procedure in the reproduction mode is described. First at step S81, it is judged whether or not a mode change from the photography mode has been made. If the change has been made, a timer T1, which is used to judge whether the camera 100' has not been operated for a specified time, is reset at step S82. Then, at
15 steps S83 through S85, the picture on the liquid crystal display 10 is changed to one for the reproduction mode.

Specifically, at step S83, image data of the highest frame number is read out of the flash memory of the memory card 56, and the image is displayed at step S84. Here, the picture shown by Fig. 32 is displayed.
20 In Fig. 32, the same reference symbols as used in Fig. 30 show the same items. What are newly displayed are a label 94 for deletion and a label 95 for one-frame display. The key 111d right under this label 94 functions as a delete key. The key 111e right under the label 95 functions as a one-frame display/thumbnail display switching key. In
25 the portion denoted by the numeral 87, the status of the camera 100' is displayed; however, the file name of the displayed image, the date and

10, and the picture on the display 10 is renewed. At step S90, the information of the displayed image is saved in the work memory.

Next, it is judged at step S91 whether or not a change of the display area size has been commanded. When the change is commanded,
5 the timer T1 is reset at step S92. Then, image data of the frame are taken into the liquid crystal display 10 again at step S93, and at step S94, the image is displayed in the area of the designated size. Subsequently, at step S95, the information of the displayed image is saved in the work memory.

10 Further, if an operation of any other key is recognized at step S96, the timer T1 is reset at step S97, and a process in compliance with the operation of the key is performed. If necessary, the picture on the liquid crystal display 10 is renewed, and the information is saved. Then, the program returns to the main routine.

15 On the other hand, if "NO" at step S96, that is, when no keys are operated, the timer T1 counts up at step S99. After it is judged at step S100 from the count-up of the timer T1 that the camera 100' has not been operated for a specified time (for example, five minutes), the information of the currently displayed image is read out of the work memory at step
20 S101. Then, the image indicated by the information is displayed again on the liquid crystal display 10 at step S102, and the timer T1 is reset at step S103.

The picture on the liquid crystal display 10 is renewed at step S102 because of the following reason. Cholesteric liquid crystal used in
25 this embodiment has an advantage of not consuming electric power while maintaining a display thereon. Accordingly, while no operation is made

causes.

Because the memory card according to this embodiment has a liquid crystal display with a memory effect, it is possible to display an error code on the display to inform the user of the kind of the error.

- 5 Further, it is possible to display the cause and the measures as well as the error code.

Table 1

Error Code	Kind of Error	Cause
1	error of data recording to memory card 1	damage on flash memory
2	Error of data recording to memory card 2	over capacity
3	error of data reading from memory card 1	damage on flash memory
4	error of data reading from memory card 2	theoretical disorder made in data recording
5	Non-operational	central control section beyond control, removal of memory card during an access

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In order to manage these errors, as Fig. 35 shows, the timing controller 70 of the memory card according to this embodiment comprises a timing signal generating section 701, an error detecting section 702, and error display data 703, a capacitor 704 and a memory managing
15 section 705.

Error of Data Recording to Memory Card 1

The timing signal generating section 701 performs display on the

liquid crystal display 10 and data recording to the flash memory controlled by the central control section 211. When data are recorded in the flash memory, the central control section 211 checks whether or not specified data are correctly recorded to the flash memory. If the central control section 211 recognizes disorder during the check, the central control section 211 sends information of an occurrence of the recording error 1 to the error detecting section 702 via the timing signal generating section 701. In response, the error detecting section 702 selects a piece of display data corresponding to the error code 1 from the error display data 703 and sends the display data to the timing signal generating section 701. Then, the display data are displayed in an appropriate place on the liquid crystal display 10.

Error of Data Recording to Memory Card 2

The memory managing section 705 has a memory which is stored with data about the remaining capacity and the number of used frames. The central control section 211 records 1024 bits of data at a time when recording data to the flash memory. When the remaining capacity of the flash memory becomes smaller than 1024 bits, the central control section 211 sends information of an occurrence of the recording error 2 to the error detecting section 702 via the timing signal generating section 701. In response, the error detecting section selects a piece of display data corresponding to the error code 2 from the error display data 703 and sends the display data to the timing signal producing section 701. Then, the data are displayed in an appropriate place on the liquid crystal display 10.

Error of Data Reading from Memory Card 1

For data reading from the flash memory, the central control section 211 designates the address in the flash memory from which data are to be read out, and data are read out in synchronization with a reading timing signal outputted from the timing signal generating section 701. At this time, if data reading from the designated address is impossible, the error detecting section 702 selects a piece of display data corresponding to the error code 3 from the error display data 703 and sends the display data to the timing signal generating section 701. Then, the data are displayed in an appropriate place on the liquid crystal display 10.

Error of Data Reading from Memory Card 2

As mentioned above, for data reading from the flash memory, the central control section 211 designates the address in the flash memory from which data are to be read out, and data are read out in synchronization with the reading timing signal outputted from the timing signal generating section 701. In this time, if any disorder of data is recognized from the check sum, it can be regarded that any disorder occurred at the time of data recording. Accordingly, the error detecting section 702 selects a piece of display data corresponding the error code 4 from the error display data 703 and sends the display data to the timing generating section 701. Then, the data are displayed in an appropriate place on the liquid crystal display 10.

Non-operational

The above-described error check processes are installed in the
25 internal routine of the central control section 211. If the central control
section 211 itself comes beyond control and stops (the system may be so

designed to shut the power off in such a case for protection of the system), the error check processes are not operative. The same thing happens when the memory card is taken out of the camera during an access.

In order to manage such a case, the memory card has a capacitor
5 704 with a capacity of approximately $300 \mu F$. If the central control section 211 comes beyond control, an error display is made by use of electricity stored in the capacitor 704.

The error detecting section 702 monitors signals exchanged between the central control section 211 and the timing signal producing
10 section 701 via a control bus. If the timing clock stops or if a memory access signal stops suddenly whereas the timing clock works, it is judged that the central control section 211 comes beyond control or that the memory card is taken out during an access. Accordingly, the error detecting section 702 selects a piece of display data corresponding to the
15 error code 5 from the error display data and sends the display data to the timing signal generating section 701. Then, the data are displayed in an appropriate place on the liquid crystal display 10.

Thus, because the liquid crystal display 10 has a memory effect, an error display can be made even when the power is off. This brings an
20 effect that the system can be protected while an error is managed.

Control Procedure Including Automatic Power-off Process

The above-described digital cameras 100 and 100' are controlled not to accept a power-off command during image writing on the liquid crystal display 10 (see steps S32 through S35 in Fig. 22 and steps S54
25 through S56 in Fig. 28). Generally, in an electronic information device which uses a battery as its driving source, for energy saving, an

automatic power-off system which automatically turns off the device when there have been no key operations for a specified time is adopted. In this case, if in the photography mode, the automatic power-off system works to shut off the power during writing of a live view image on the liquid crystal display 10, an incomplete image will be continuously
5 displayed, which is ugly.

In including such an automatic power-off task in the control procedure for the photography mode shown by Fig. 29, as Figs. 36 and 37 show, steps S70a, S71a, S78a, S78b and S78c shall be added. The
10 processes at the other steps in Figs. 36 and 37 are performed in the same ways as described with reference to Fig. 29.

The automatic power-off system is described. When a supply of electric power to the image-pick up unit 103 is shut off after image pick-up, an automatic power-off timer is reset at step S70a. Thereafter, if no
15 key operations are recognized ("NO" at step S71), the timer counts up at step S78a, and it is judged from the count value of the timer at step S78b whether or not a specified time has passed. If the specified time has not passed, the processes at step S73 through S77 are performed, and when the specified time has passed (with no key operations), a power-off process
20 is performed at step S78c. If any key operation is recognized at step S71, the automatic power-off timer is reset at step S71a.

By adopting an automatic power-off system as shown by Figs. 36 and 37, it never occurs that a power-off process at step S78c is performed during image writing on the liquid crystal display 10 (step S63), and
25 whenever a power-off process is automatically performed, image writing on the liquid crystal display 10 has been completed. Thus, there are no

possibilities that an incomplete picture is continuously displayed.

Other Embodiments

In the embodiments above, memory cards are described as examples of storage media. It is, however, possible to provide a liquid
5 crystal display on a surface of an electromagnetic disk or on a surface of a floppy disk. Also, a plurality of liquid crystal displays can be provided on one storage medium. The material with a memory effect to which the present invention is applicable is not limited to liquid crystal and, for example, may be a material which displays color by heat.

10 Although the present invention has been described in connection with the preferred embodiments, it is to be noted that various changes and modifications are possible to those who are skilled in the art. Such changes and modifications are to be understood as being within the scope of the present invention.

WHAT IS CLAIMED IS:

1. An electronic information device comprising:
a display which uses a material with a memory effect;
5 an electric power source which supplies driving power to the display; and
a controller which, in response to a command to turn off the electric power source which is issued while the display is performing writing by consuming electric power supplied from the electric power
10 source, turns off the electric power source after completion of the writing.
2. The electronic information device according to claim 1, wherein information is written on the display based on image data.
- 15 3. The electronic information device according to claim 2, further comprising:
an image pick-up unit which picks up an image of an object by use of an image sensor and produces the image data.
- 20 4. The electronic information device according to claim 1, wherein information written on the display is a thumbnail picture which shows a plurality of thumbnail images side by side.
5. An electronic information device comprising:
25 a display which uses a material with a memory effect;
an electric power source which supplies driving power to the

display; and

a controller which performs the following processes:

an automatic power-off process which turns off the electric power source automatically at a specified time; and

5 a delay process which when the display is performing writing by consuming electric power supplied from the electric power source, delays execution of the automatic power-off process so that the electric power source is turned off after completion of the writing.

10 6. The electronic information device according to claim 5, further comprising:

a timer which counts a specified time period from a specified operation of the electronic information device and determines the specified time to turn off the electric power source.

15

7. The electronic information device according to claim 6, wherein the specified operation includes an operation of a key switch.

8. The electronic information device according to claim 5, wherein
20 information is written on the display based on image data.

9. The electronic information device according to claim 8, further comprising:

an image pick-up unit which picks up an image of an object by use
25 of an image sensor and produces the image data.

10. The electronic information device according to claim 5, wherein information written on the display is a thumbnail picture which shows a plurality of thumbnail images side by side.

5 11. An electronic information device comprising:
 a display using a material with a memory effect;
 a first input member with which an operator inputs a specified command; and

10 a controller which when the first input member is operated while writing on the display is being performed, invalidates the command sent from the first input member and when the first input member is operated after completion of the writing, controls the electronic information device in accordance with the command sent from the first input member.

15 12. The electronic information device according to claim 11, wherein the first input member is to input a command to shut off the supply of electric power to the display.

20 13. The electronic information device according to claim 11, further comprising:

a second input member with which an operator inputs a command which is different from the command inputted with the first input member;

25 wherein, the controller controls the electronic information device in accordance with the command sent from the second input member regardless of whether or not writing on the display is being performed.

14. The electronic information device according to claim 13, wherein the second input member is a shutter button.

15. A method of controlling an electronic information device, said
5 method comprising the steps of:

writing information on a display which uses a material with a memory effect by supplying electric power to the display from an electric power source;

commanding a power-off of the electric power source; and

10 when a power-off of the electric power source is commanded while the display is performing writing by consuming electric power supplied from the electric power source, executing the power-off command after completion of the writing.

15 16. The control method according to claim 15, wherein information is written on the display based on image data.

17. The control method according to claim 16, further comprising the step of:

20 picking up an image of an object by use of an image sensor and producing the image data.

18. The control method according to claim 15, wherein information written on the display is a thumbnail picture which shows thumbnail
25 images side by side.

19. A method of controlling an electronic information device, said method comprising:

a write step of writing information on a display which uses a material with a memory effect by supplying electric power to the display
5 from an electric power source;

an automatic power-off step of turning off the electric power source at a specified time automatically; and

a delay step of, when writing on the display is being performed, delaying execution of the power-off step so that the electric power source
10 is turned off after completion of the writing.

20. The control method according to claim 19, wherein the specified time to turn off the electric power source is determined by a timer which counts a specified time period from a specified operation of the electronic
15 information device.

21. The control method according to claim 20, wherein the specified operation includes an operation of a key switch.

22. The control method according to claim 21, wherein information is written on the display based on image data.

23. The control method according to claim 22, further comprising:
an image pick-up step of picking up an image of an object by use of
25 an image sensor and producing the image data.

24. A method of controlling an electronic information device, said method comprising the steps of:

writing information on a display which uses a material with a memory effect by supplying electric power to the display from an electric power source;

issuing a specified command by operating a first input member; and

when the first input member is operated while writing on the display is being performed, invalidating the command sent from the first input member, and when the first input member is operated after completion of the writing, controlling the electronic information device in accordance with the command sent from the first input member.

25. The control method according to claim 24, wherein the first input member is to issue a command to shut off the supply of electric power to the display.

26. The control method according to claim 26, further comprising the steps of:

issuing another command by operating a second input member; and

controlling the electronic information device in accordance with the command sent from the second input member regardless of whether or not writing on the display is being performed.

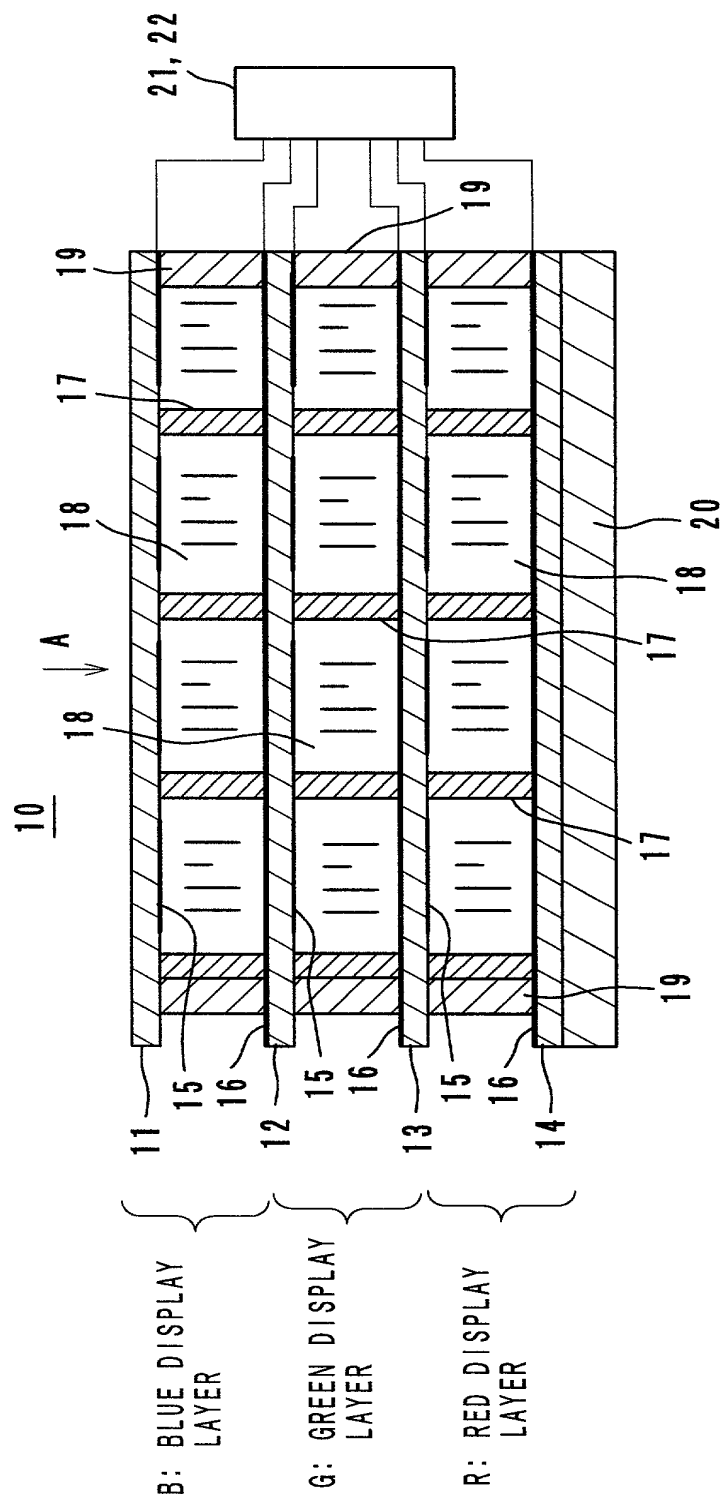
27. The control method according to claim 26, wherein the second

input member is a shutter button.

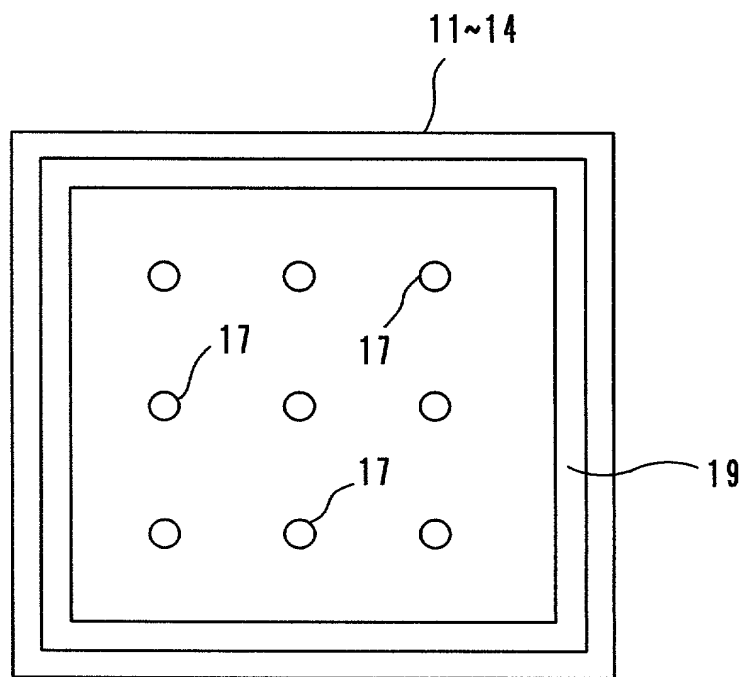
ABSTRACT OF THE DISCLOSURE

An electronic information device which uses a memory card to which a liquid crystal display using liquid crystal with a memory effect is
5 attached. If a command to turn off the electric power source is issued during writing of information on the liquid crystal display, a power-off process is executed after completion of the writing. This electronic information device is adapted, for example, to be used as a digital camera.

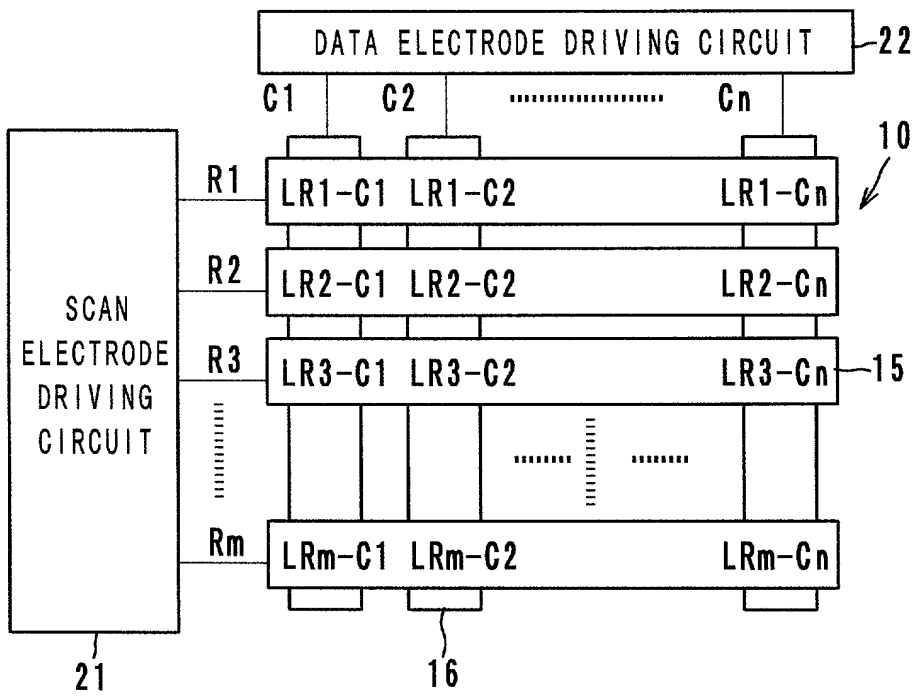
F / G. 1



F I G . 2



F / G . 3



F / G . 4

→ ROW

P11	P12		P1n
P21	P22		P2n
P31	P32		P3n
		Pij	
Pm1	Pm2		Pmn

↓ COLUMN



FIG. 7

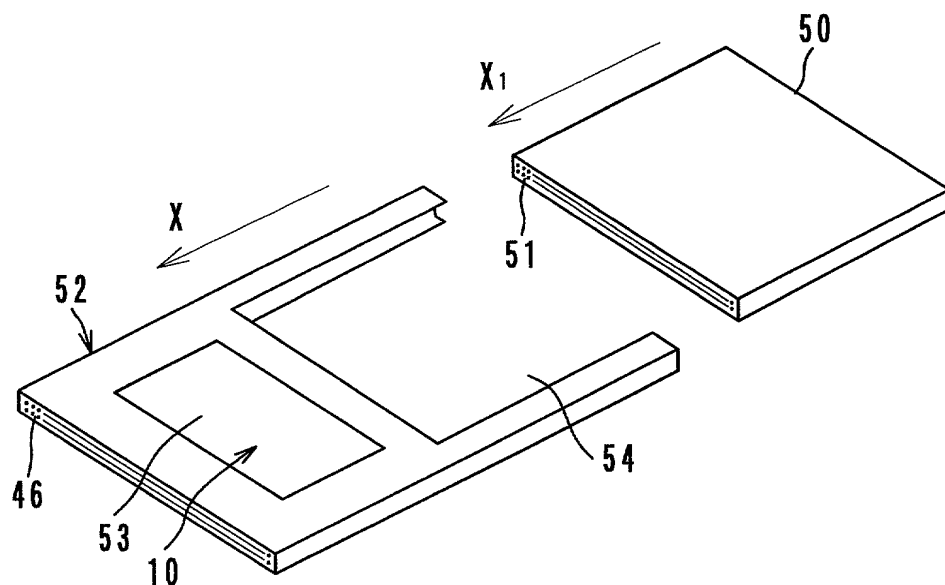


FIG. 8

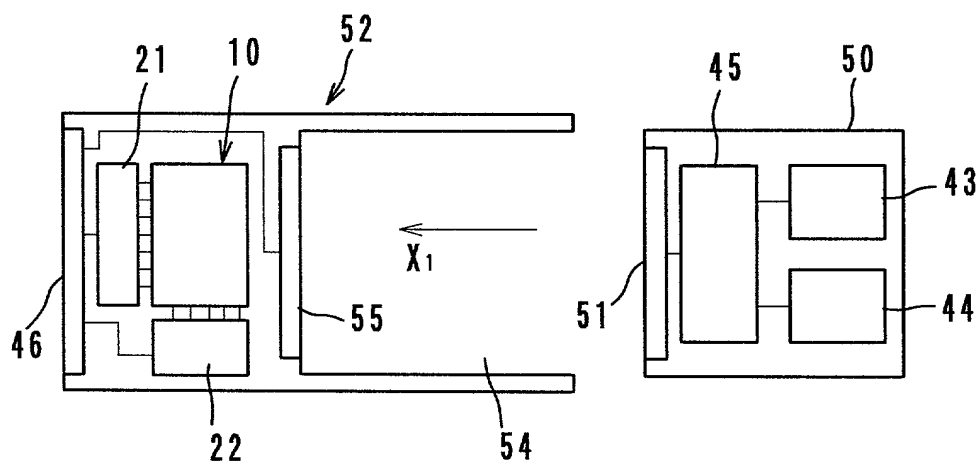
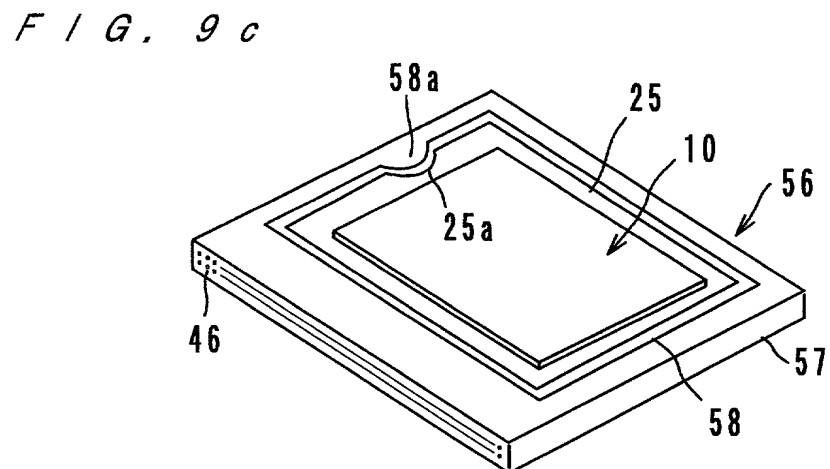
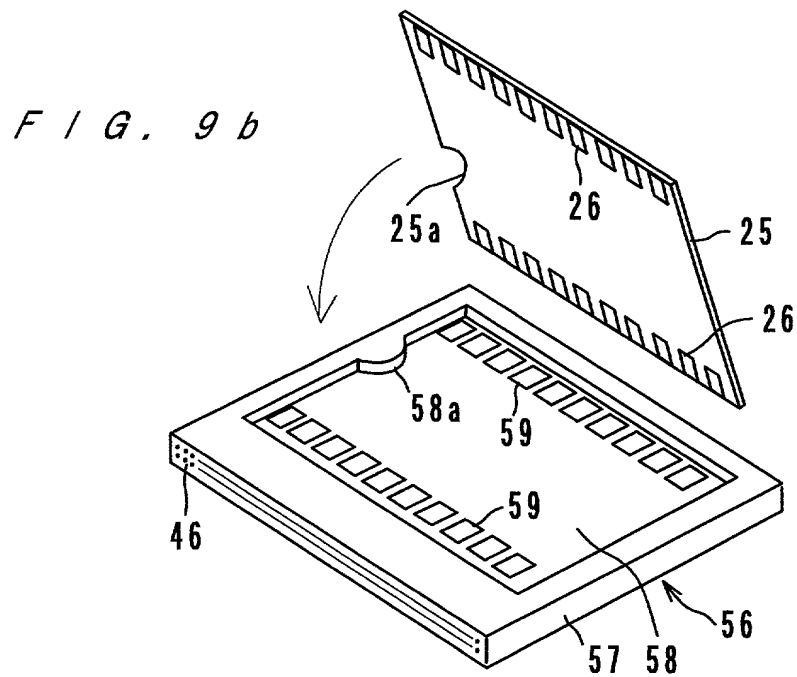
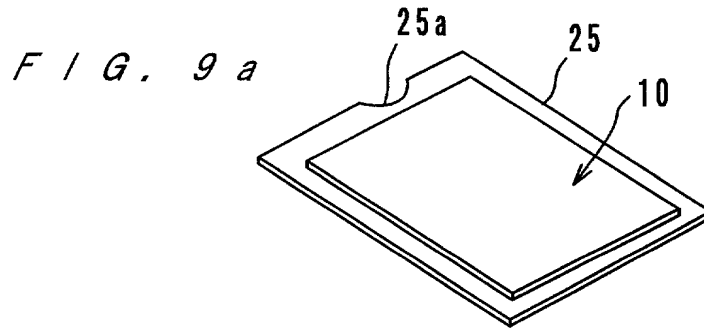


FIG. 9



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FIG. 10

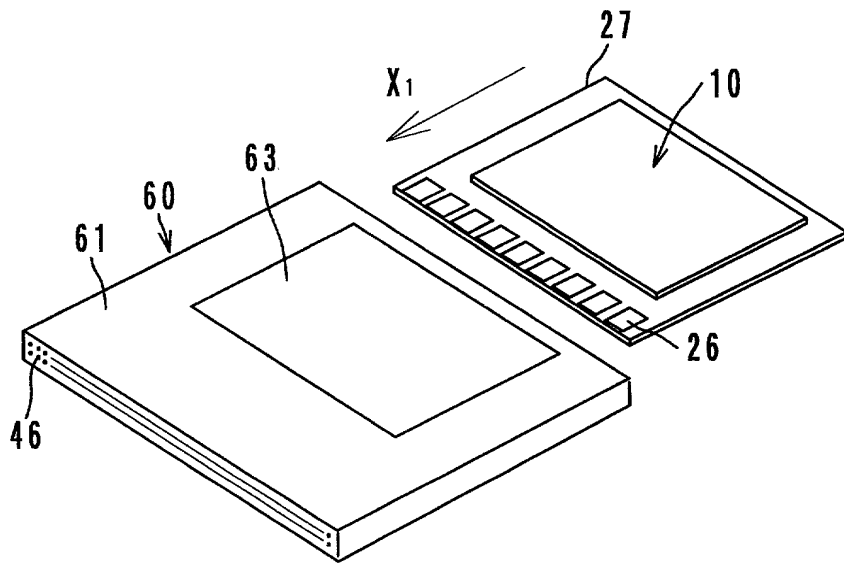
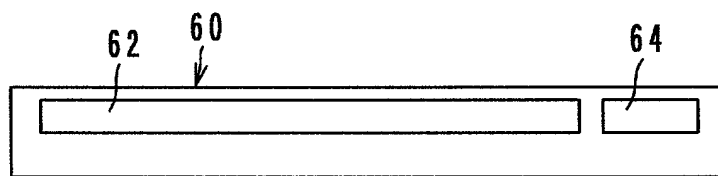
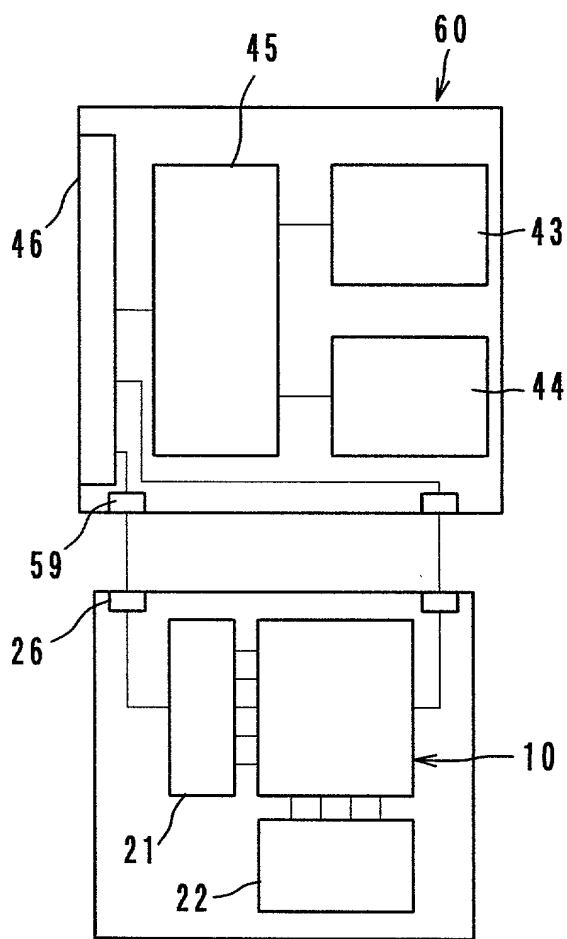


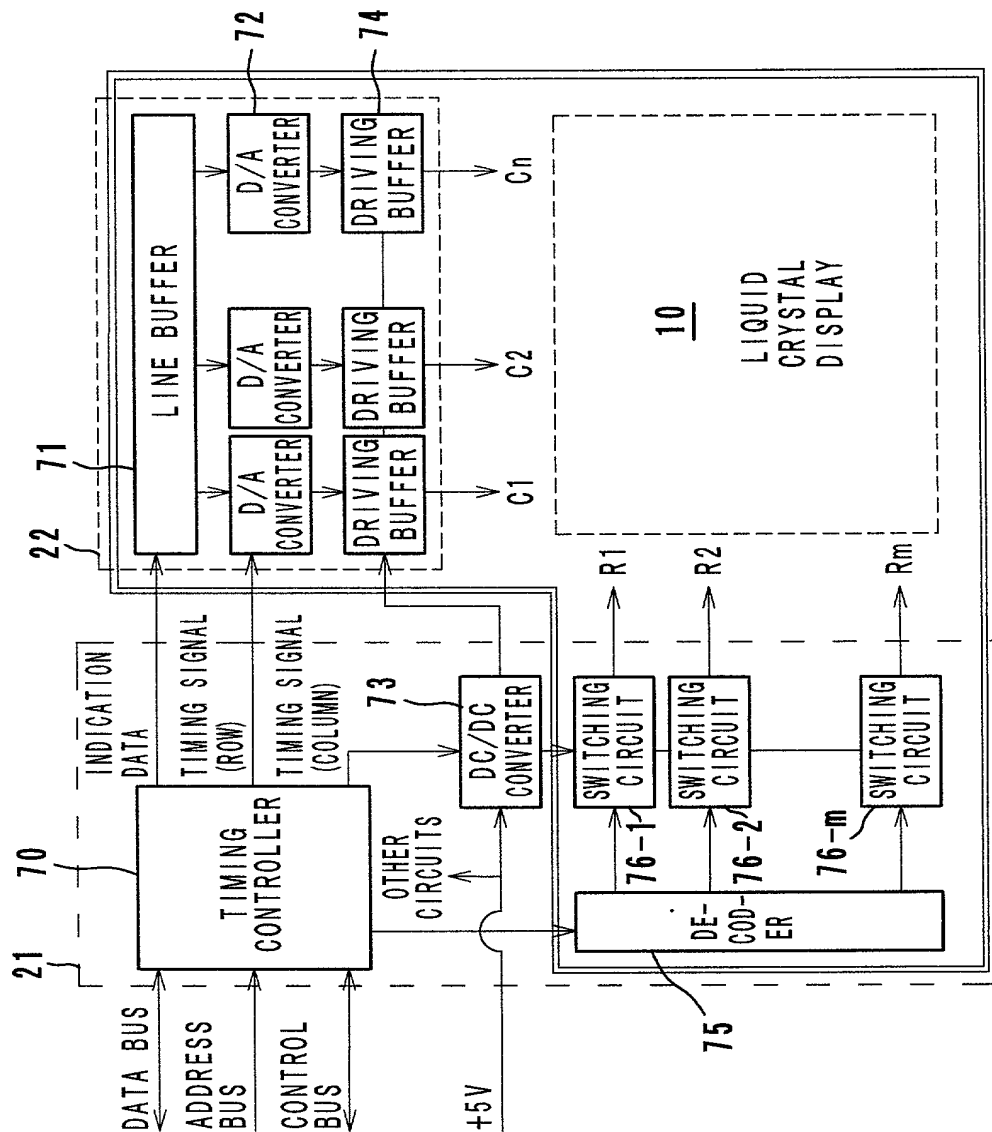
FIG. 11



F I G . 1 2



F I G. 1 3



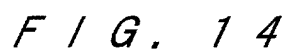


FIG. 16

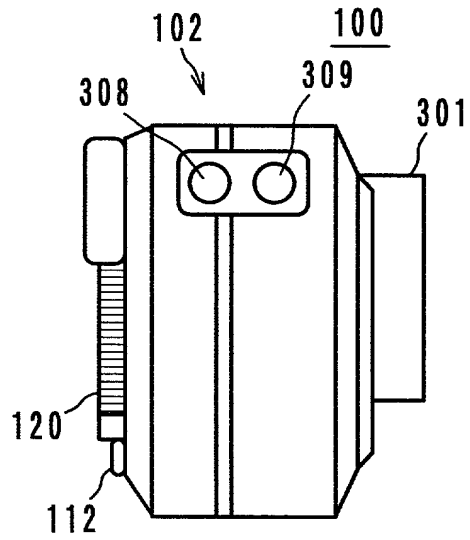
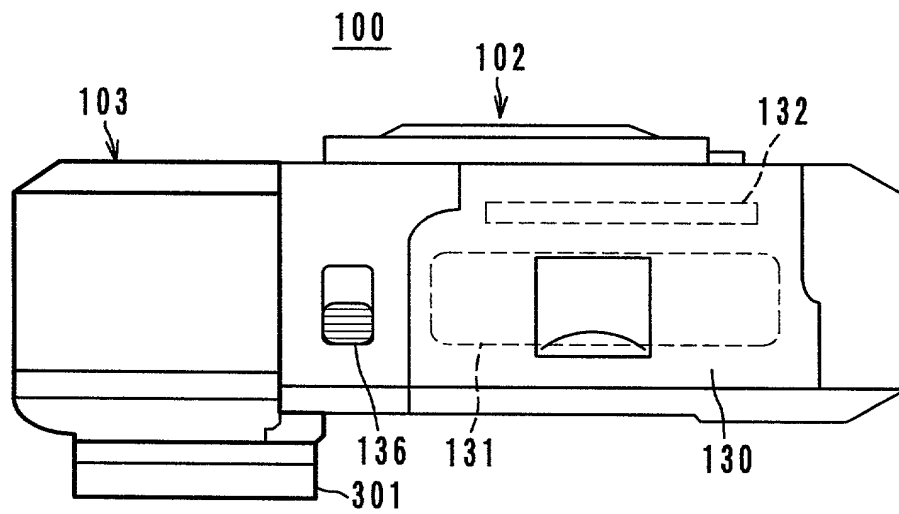


FIG. 17



F / G . 1 8

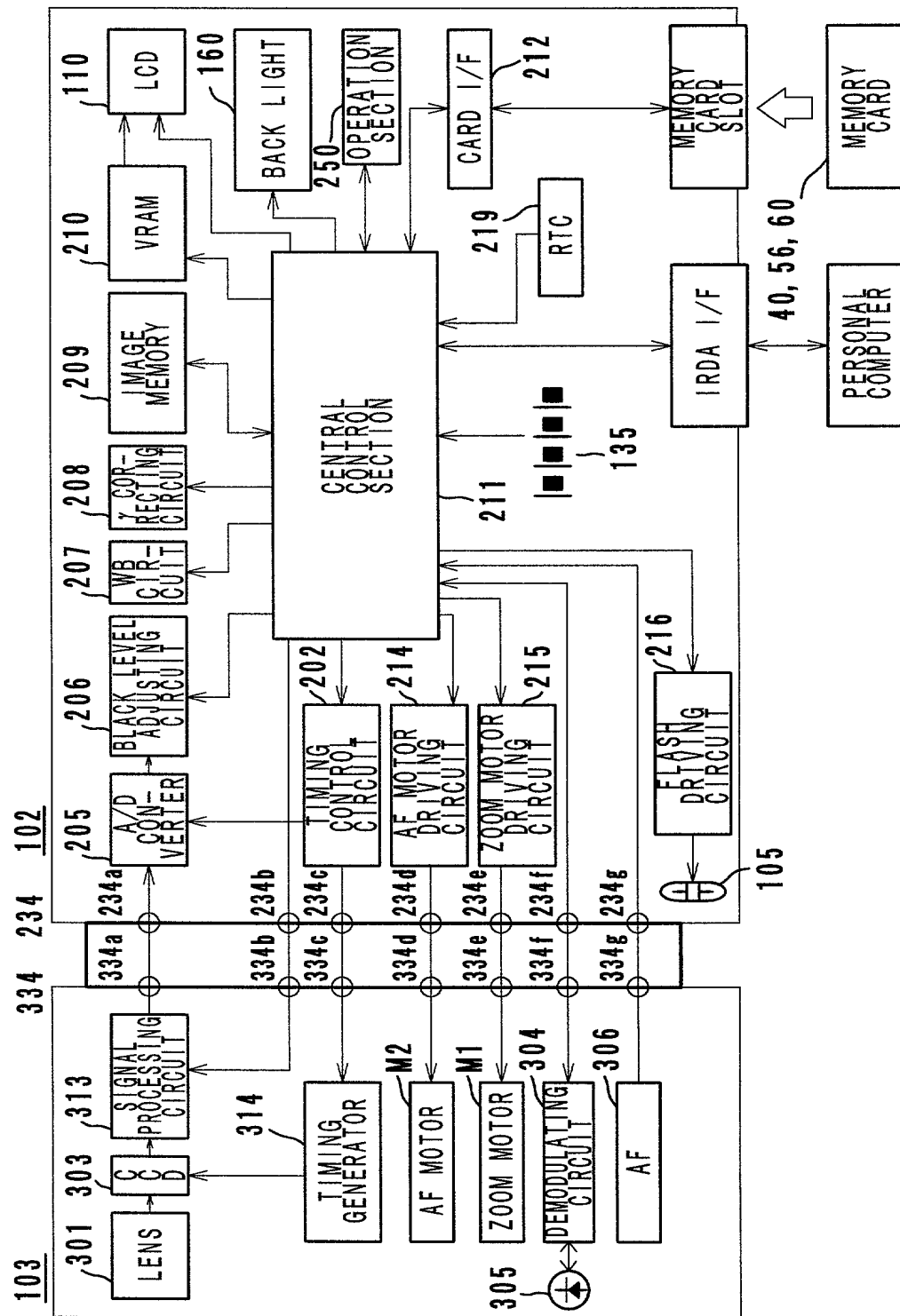


FIG. 19

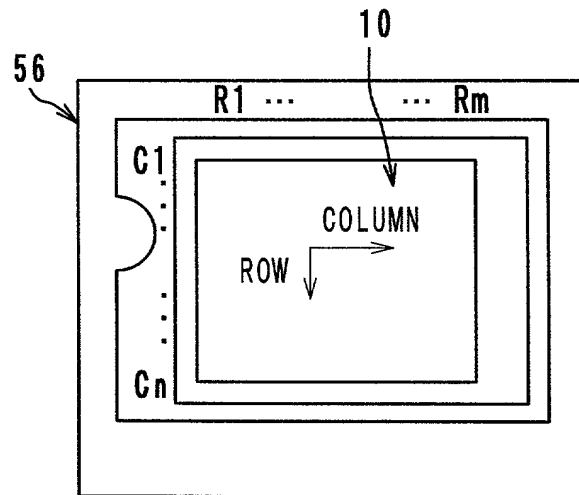


FIG. 20

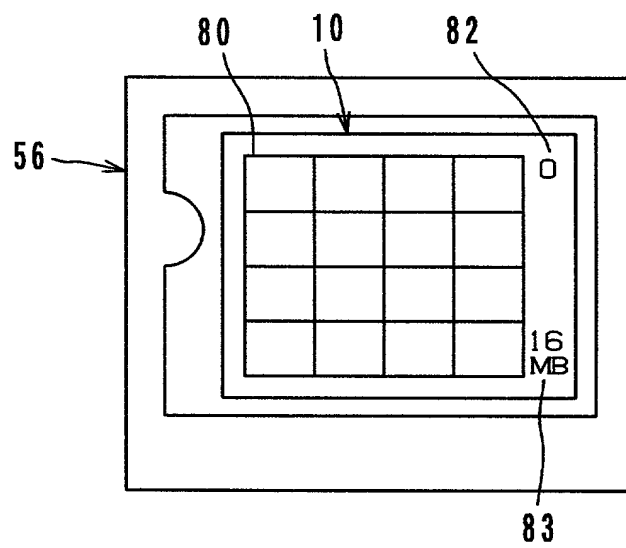
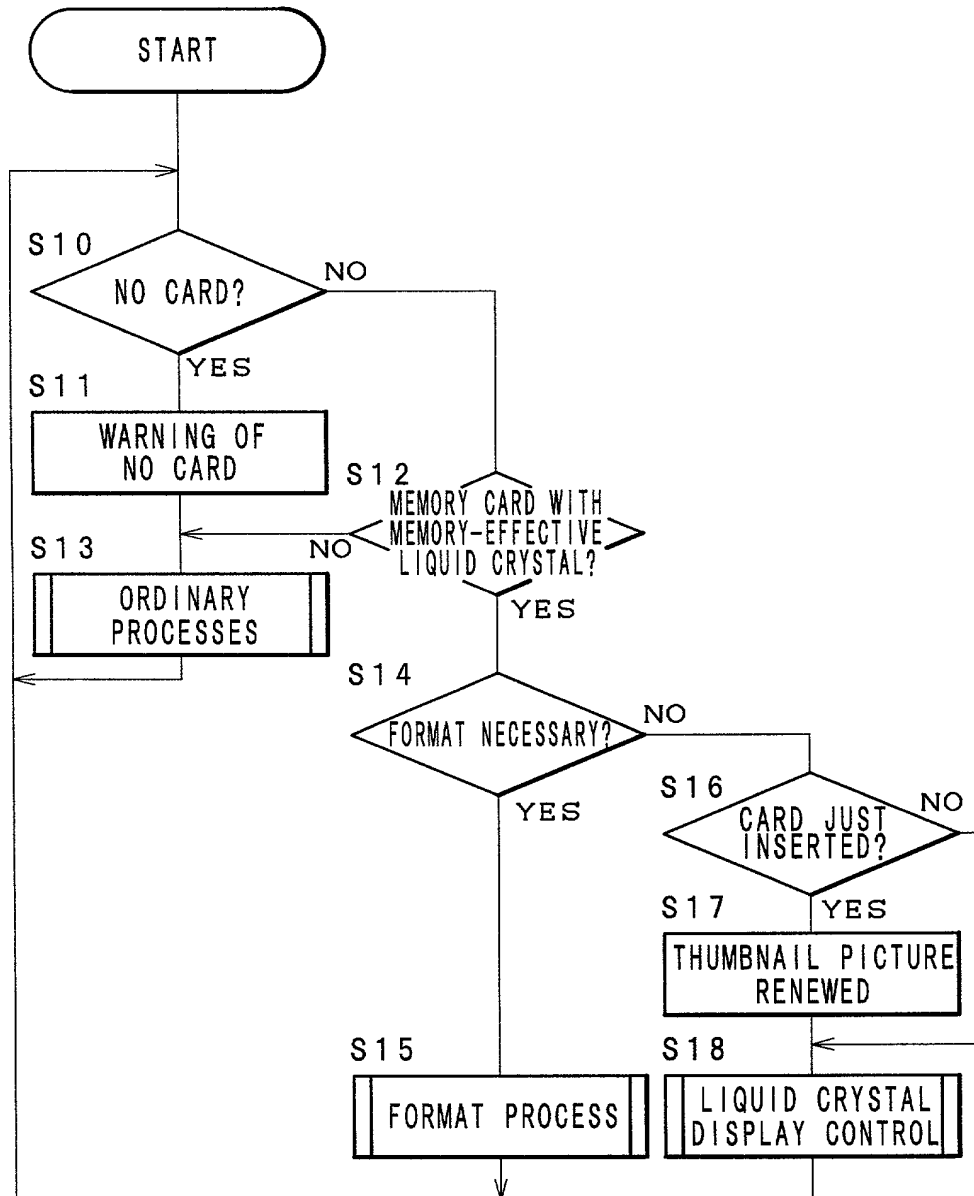
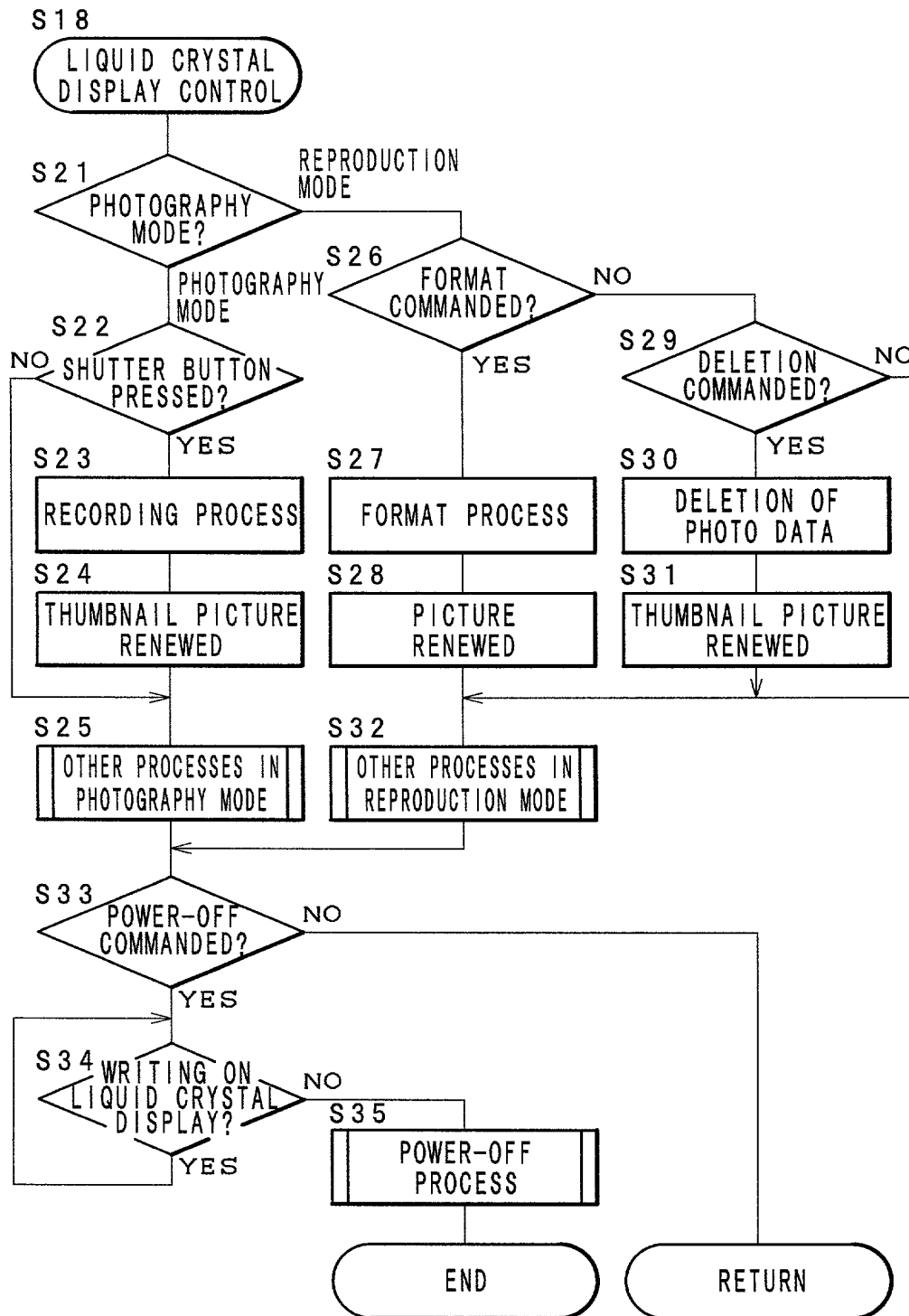


FIG. 21



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FIG. 22



F / G . 2 3

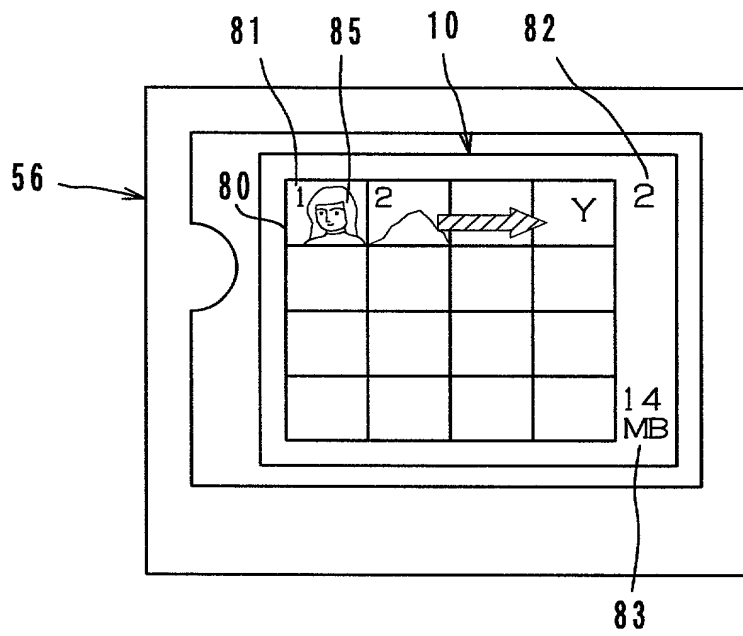


FIG. 24

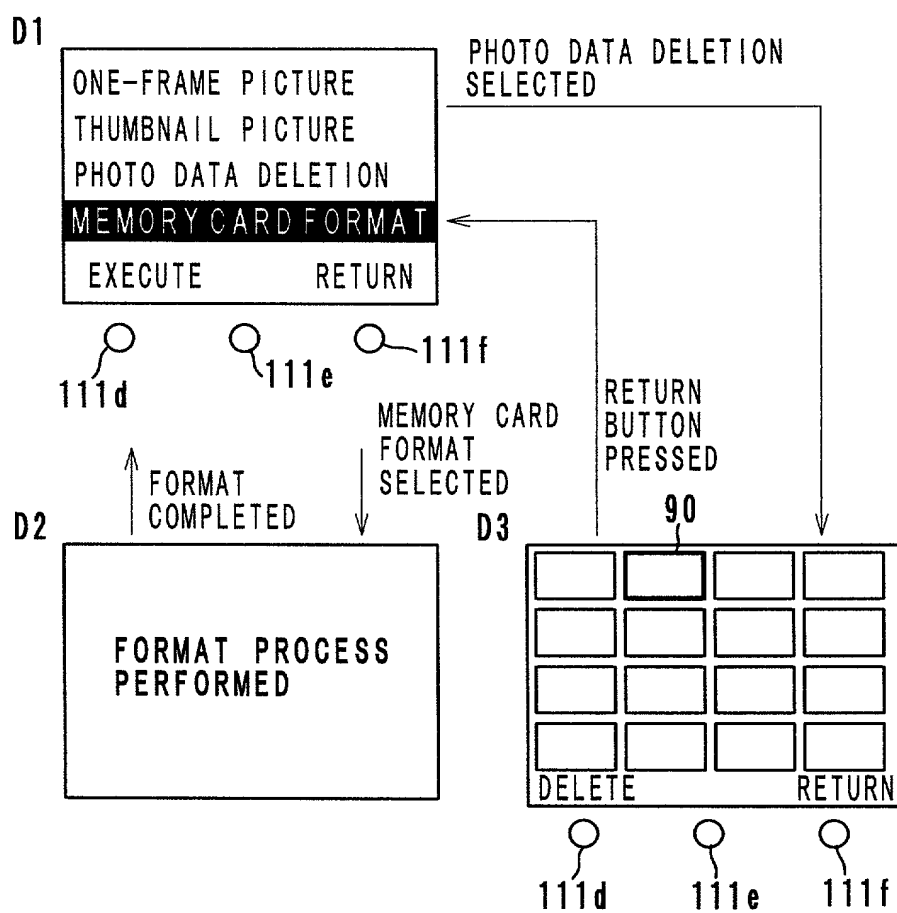


FIG. 25

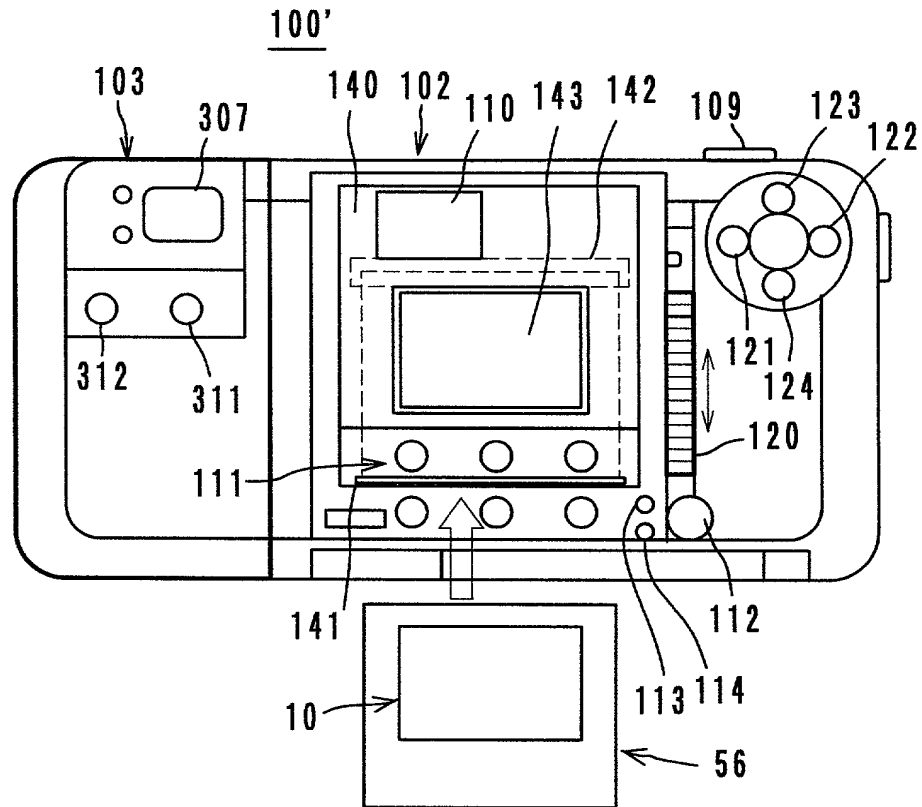


FIG. 26

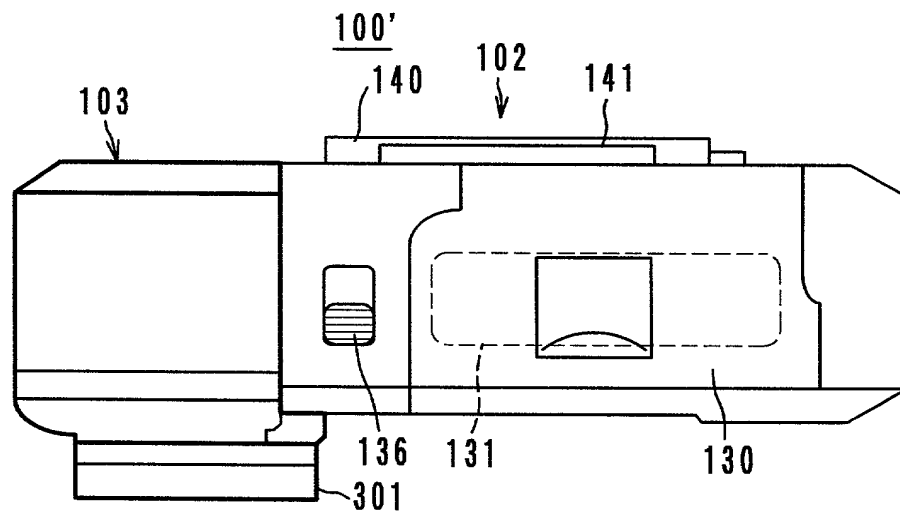
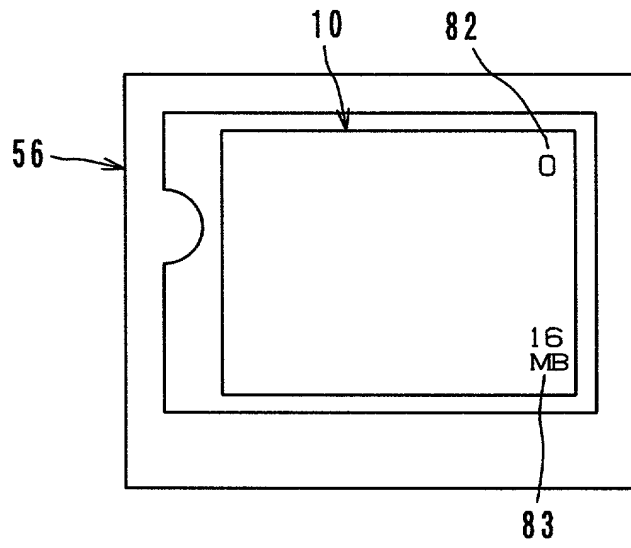
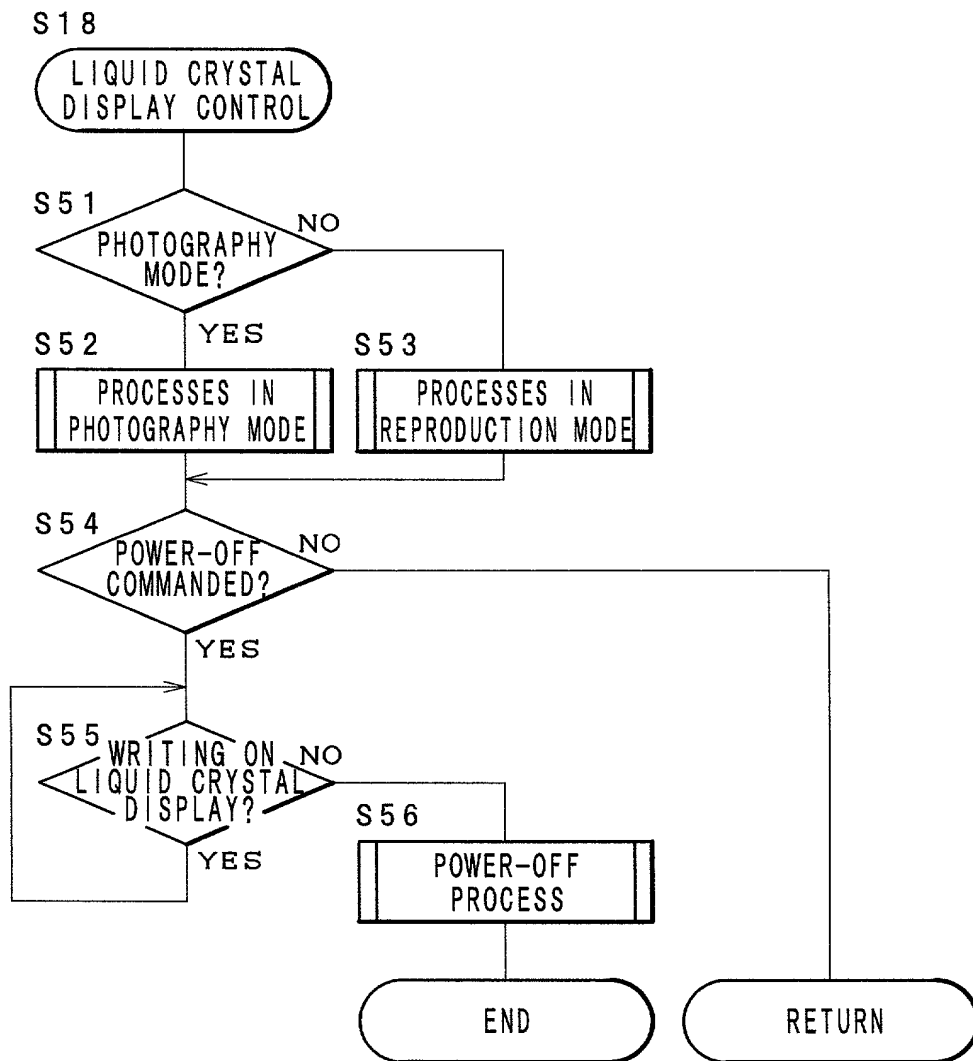


FIG. 27



F I G . 2 8



00527350 034700

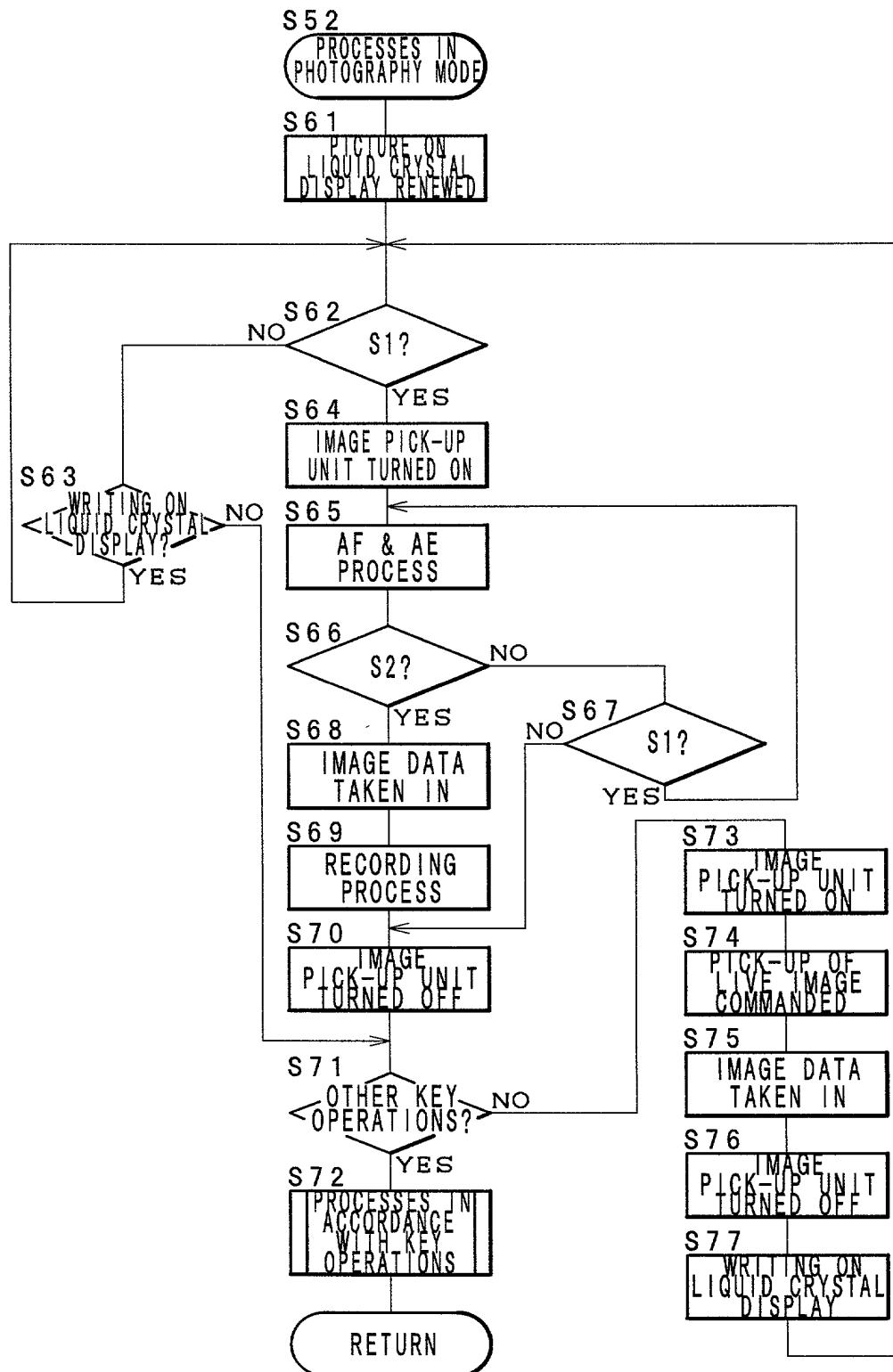
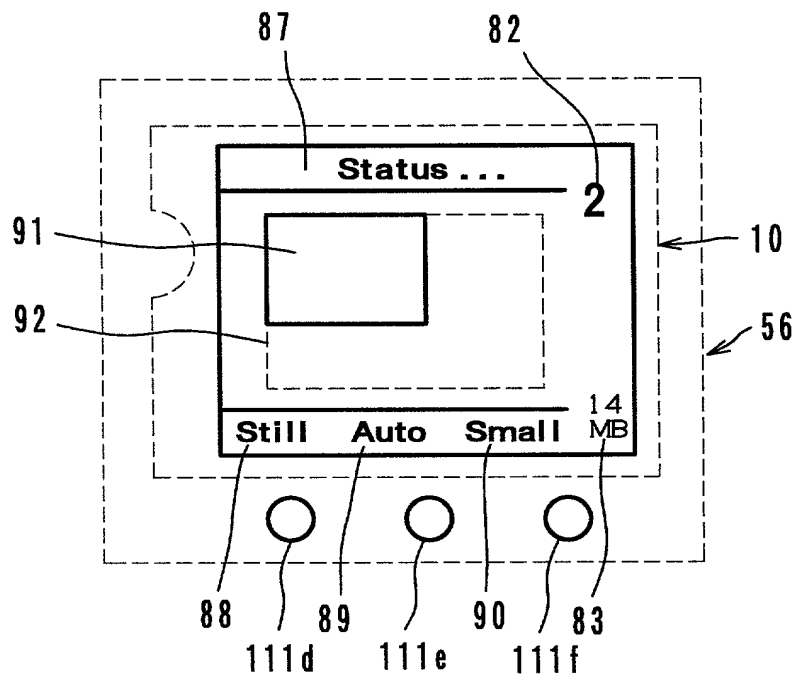
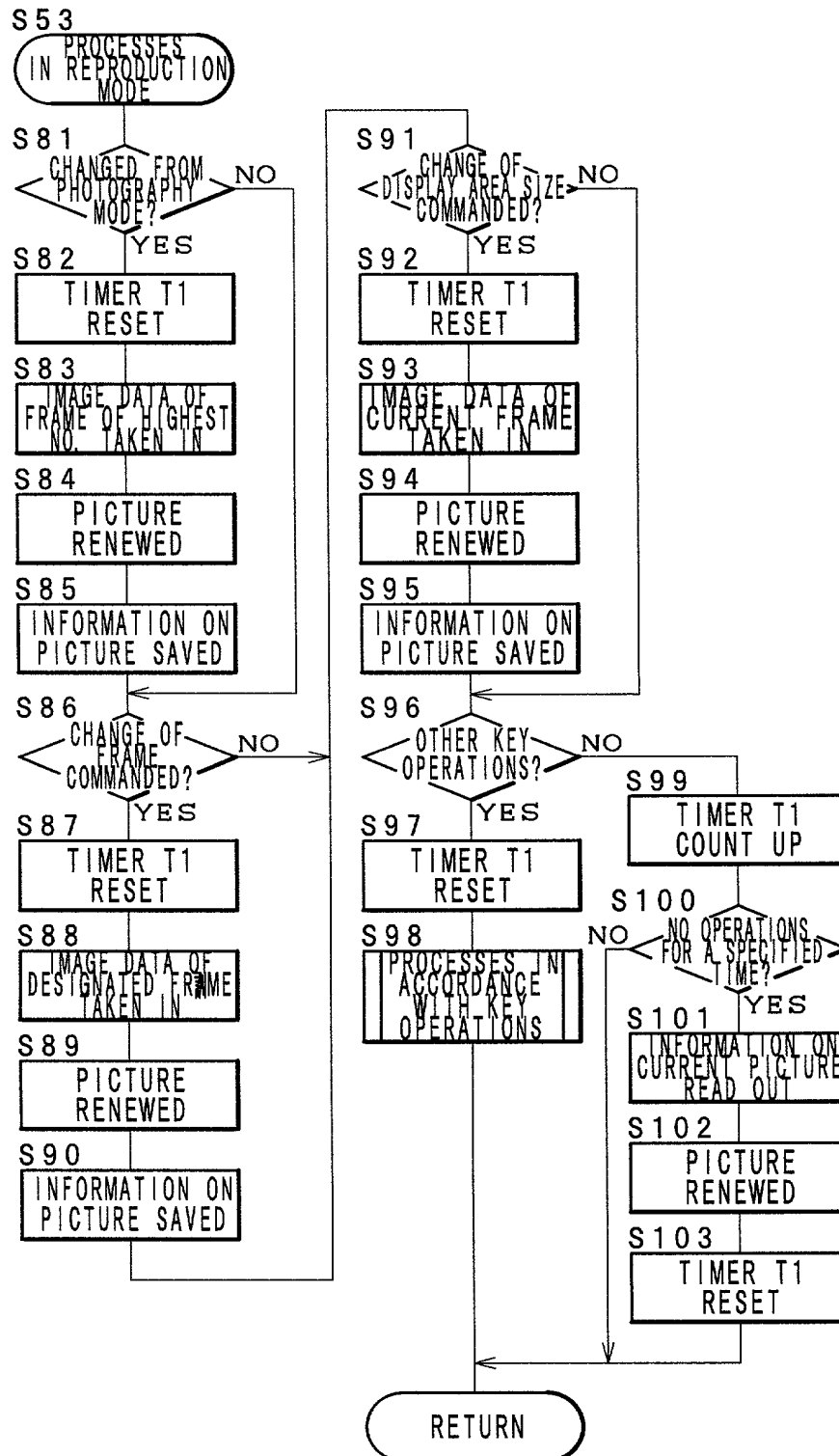


FIG. 30



F I G . 3 1



0027350 034700

F I G . 3 2

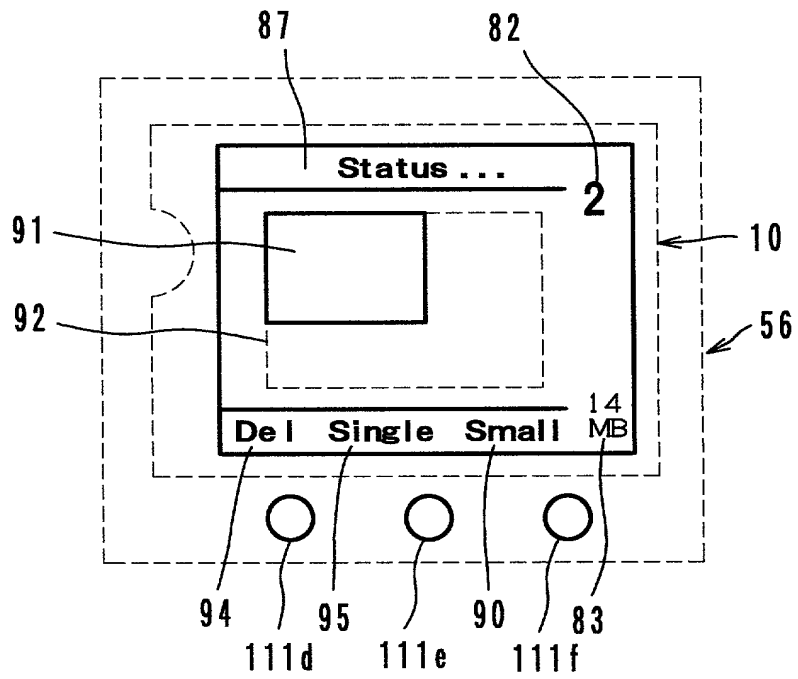
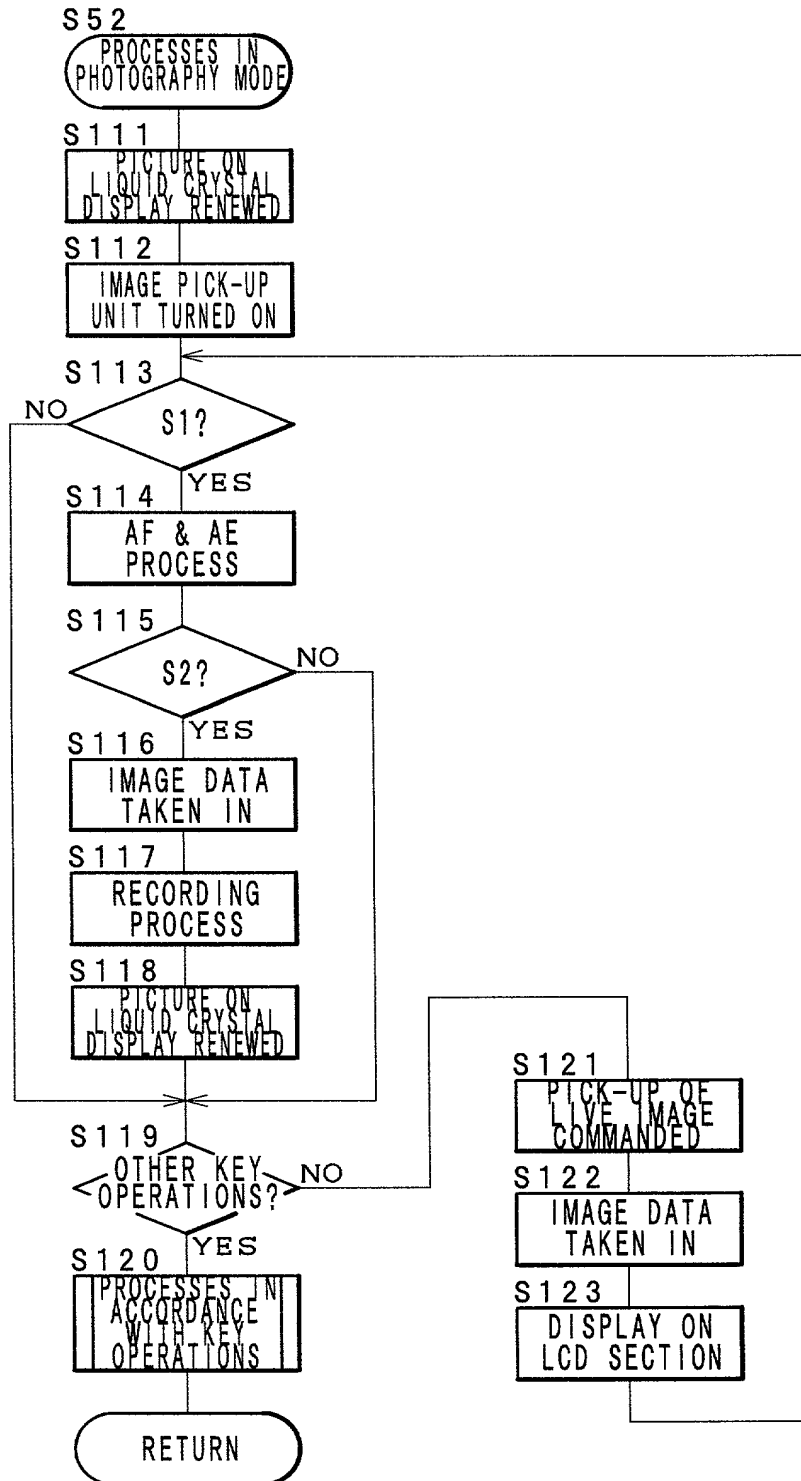


FIG. 33



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FIG. 34

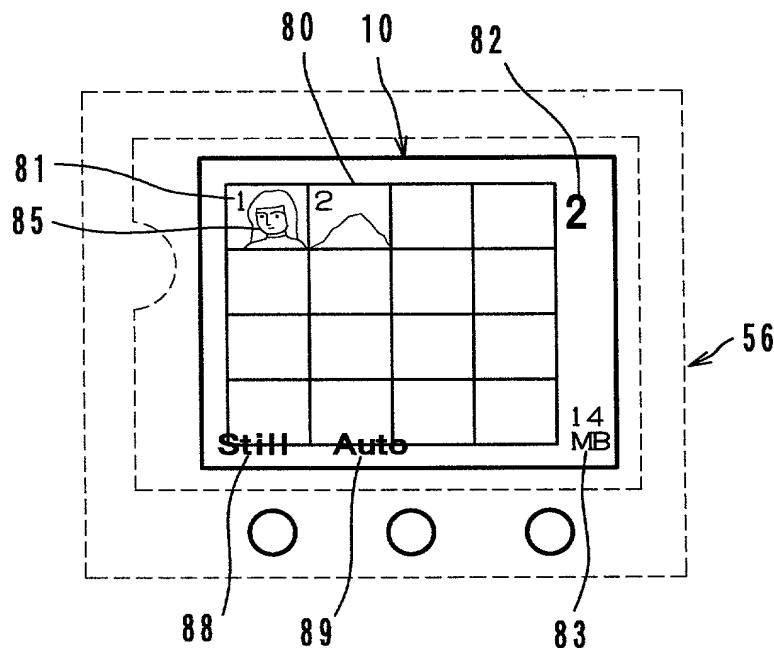
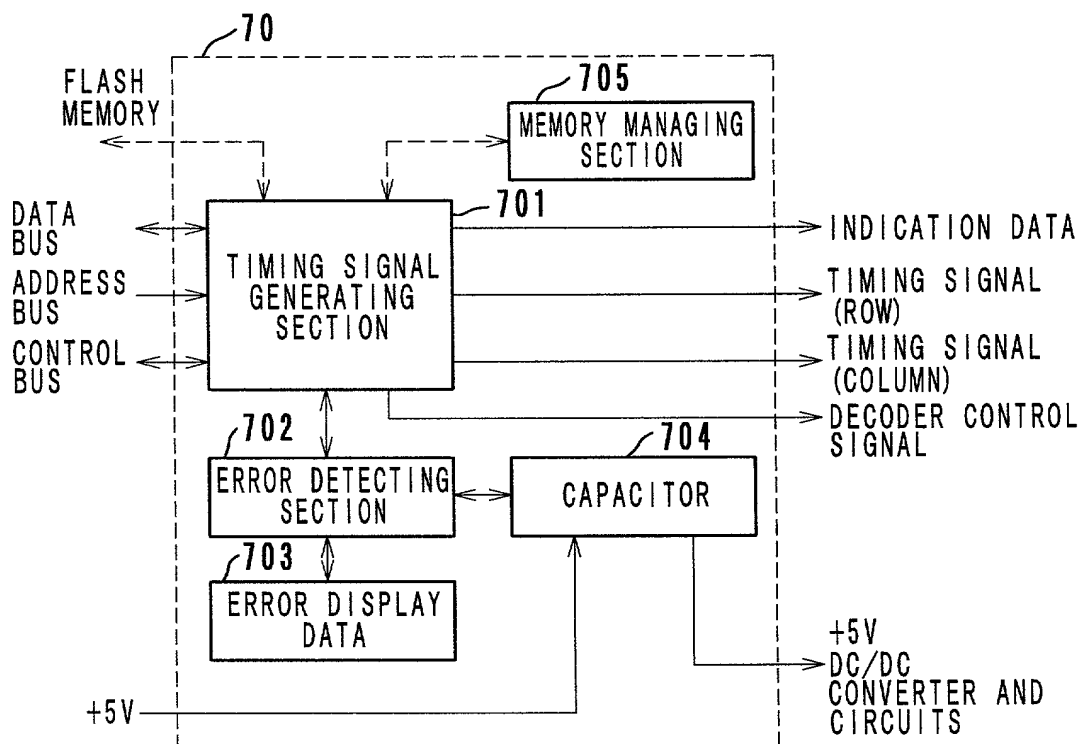
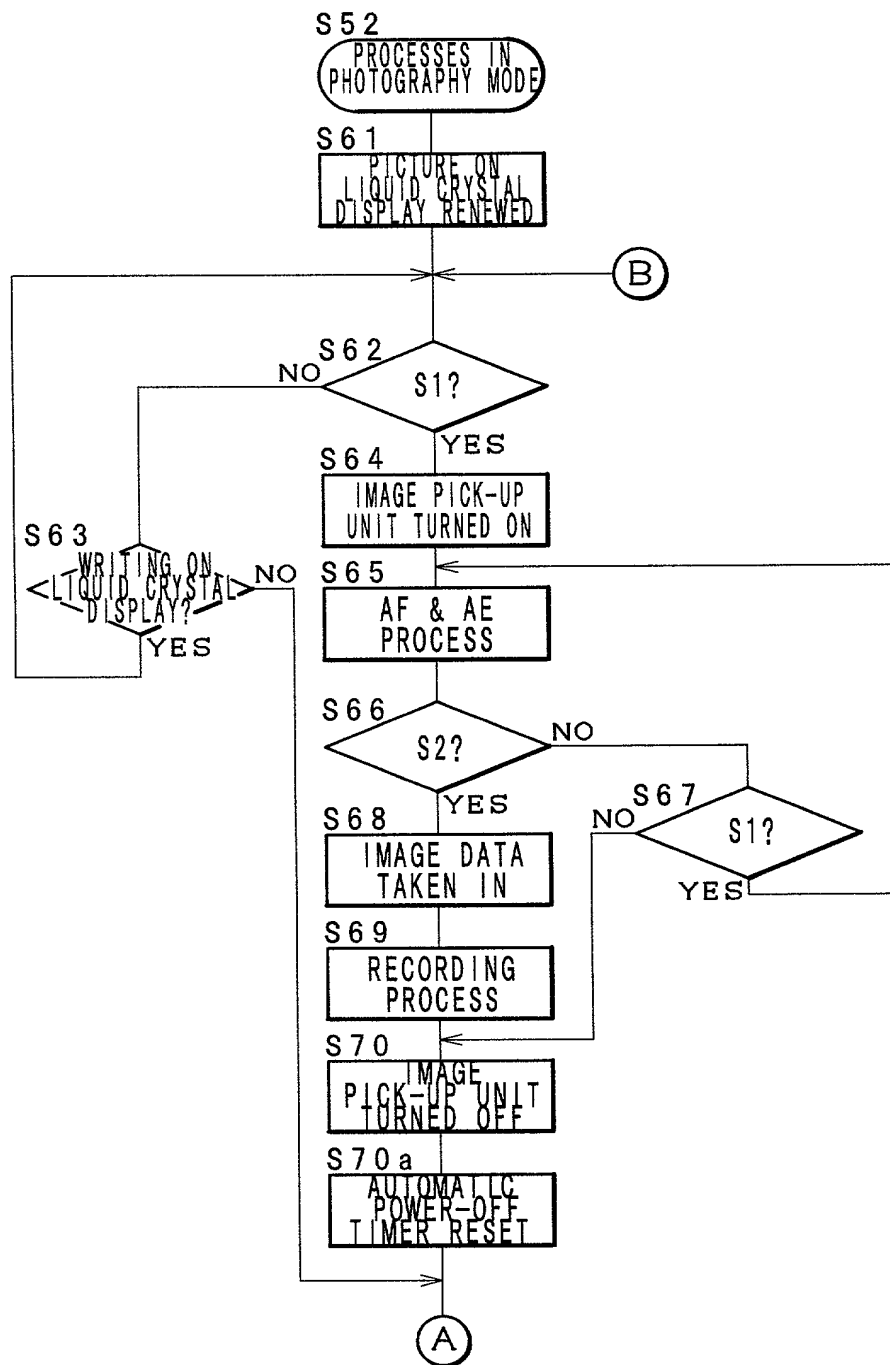


FIG. 35

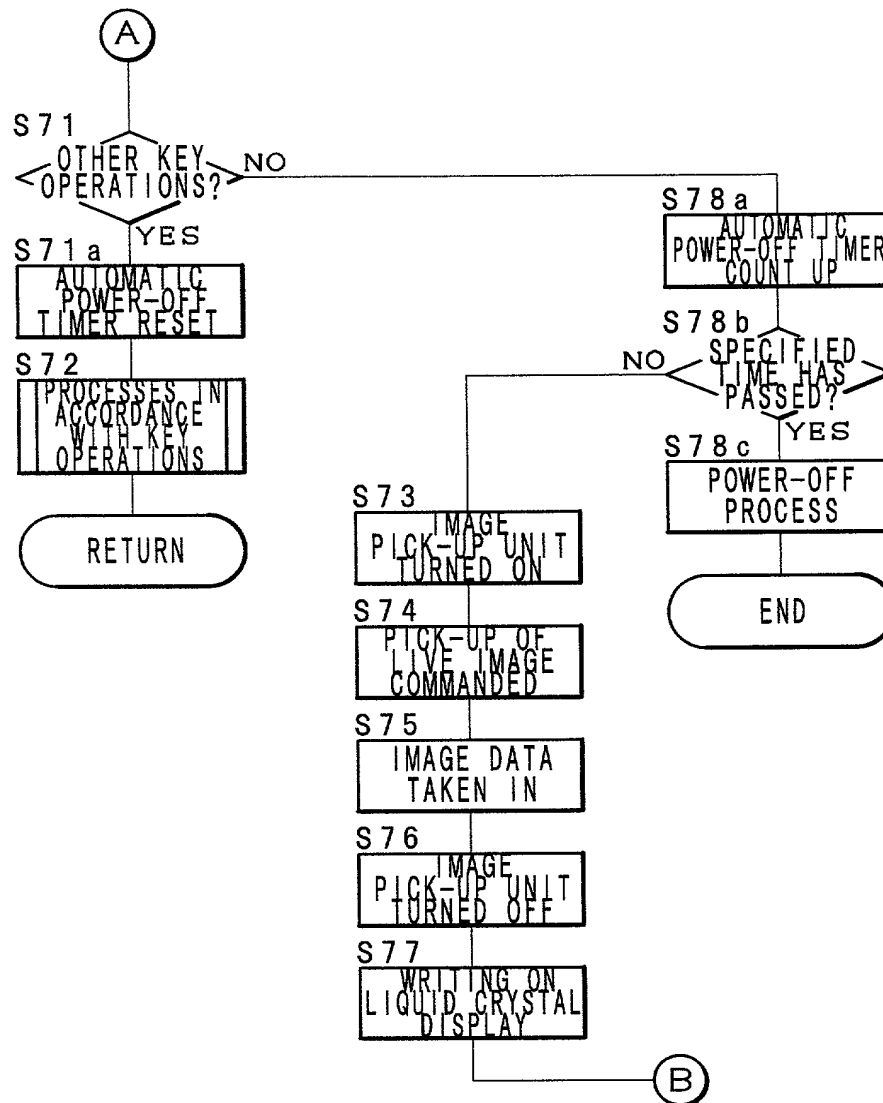


F I G . 3 6



00270 05E22550

FIG. 37



Attorney Docket No. _____

DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship
are as stated next to my name.

I believe I am the original, first and sole inventor
(if only one name is listed below) or I and the other
persons listed below are the original, first and joint
inventors (if plural names are listed below) of the
subject matter which is claimed and for which a patent is
sought on the invention entitled

ELECTRONIC INFORMATION DEVICE AND CONTROL METHOD THEREOF

the specification of which is attached hereto unless the
following box is checked:

☐ was filed on _____
as United States Application Number or
PCT International Application Number
_____ and was amended on
_____ (if applicable).

I hereby state that I have reviewed and understand
the contents of the above identified specification,
including the claims, as amended by any amendment
referred to above.

I acknowledge the duty to disclose information which
is material to patentability as defined in Title 37, Code
of Federal Regulations, Section 1.56.

00770 0522550

I hereby claim foreign priority under Title 35, United States Code, Section 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN APPLICATION(S)

Priority
Not Claimed

<u>11-78117 Pat.</u> (Number)	<u>Japan</u> (Country)	<u>23/03/1999</u> (Day/Month/Year Filed)	<input type="checkbox"/>
<u> </u> (Number)	<u> </u> (Country)	<u> </u> (Day/Month/Year Filed)	<input type="checkbox"/>
<u> </u> (Number)	<u> </u> (Country)	<u> </u> (Day/Month/Year Filed)	<input type="checkbox"/>
<u> </u> (Number)	<u> </u> (Country)	<u> </u> (Day/Month/Year Filed)	<input type="checkbox"/>
<u> </u> (Number)	<u> </u> (Country)	<u> </u> (Day/Month/Year Filed)	<input type="checkbox"/>

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

<u> </u> (Application No.)	<u> </u> (Filing Date)
<u> </u> (Application No.)	<u> </u> (Filing Date)

002750 031700

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Appl. No.)	(Filing Date)	(Status: Patented, Pending, Abandoned)
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(Appl. No.)	(Filing Date)	(Status: Patented, Pending, Abandoned)
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

002750-03400

John J. Arnott, Reg. No. 39,095
Charles S. Cotropia, Reg. No. 27,189
Kathi A. Cover, Reg. No. 37,803
Daren C. Davis, Reg. No. 38,425
William R. Gustavson, Reg. No. 29,160
David L. Hitchcock, Reg. No. 30,067
Kelly J. Kubasta, Reg. No. 44,196
William D. McSpadden, Reg. No. 44,234
Gary A. Ray, Reg. No. 40,313
Steven P. Rhines, Reg. No. 38,595
Thomas N. Tarnay, Reg. No. 41,341
James W. Williams, Reg. No. 20,047

Send correspondence to:	Direct telephone calls to:
SIDLEY & AUSTIN	<u>James W. Williams</u>
717 North Harwood	Direct: <u>(214) 981-3328</u>
Suite 3400	Main: <u>(214) 981-3300</u>
Dallas, Texas 75201-6507	Attorney Docket No.: <u> </u>

Full name of sole or first inventor

<u>Masahito</u>	<u>(NMI)</u>	<u>NIIKAWA</u>
First	Middle	Last

Inventor's signature: Masahito Niihara

Date: Feb. 25, 2000

Residence: Sakai-Shi, Osaka, Japan
(city) (prefecture) (country)

Citizenship: Japan

Post Office Address: c/o MINOLTA CO., LTD.,
Osaka Kokusai Building, 3-13, 2-Chome, Azuchi-Machi,
Chuo-Ku, Osaka-Shi, Osaka 541-8556, Japan

[illegible]

[illegible]

Chuo-Ku, Osaka-Shi, Osaka 541-8556, Japan